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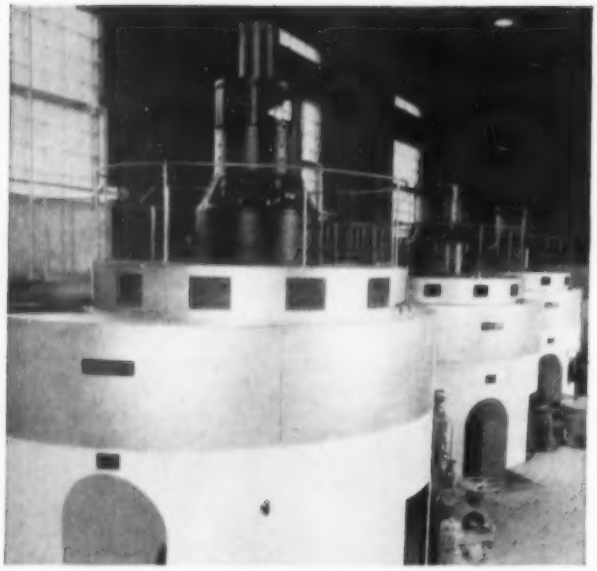
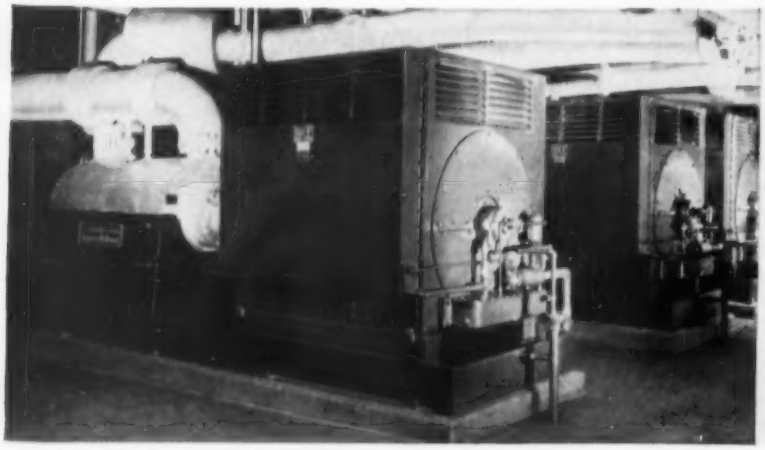
Once Again . . .

ELLIOTT

equipment was selected

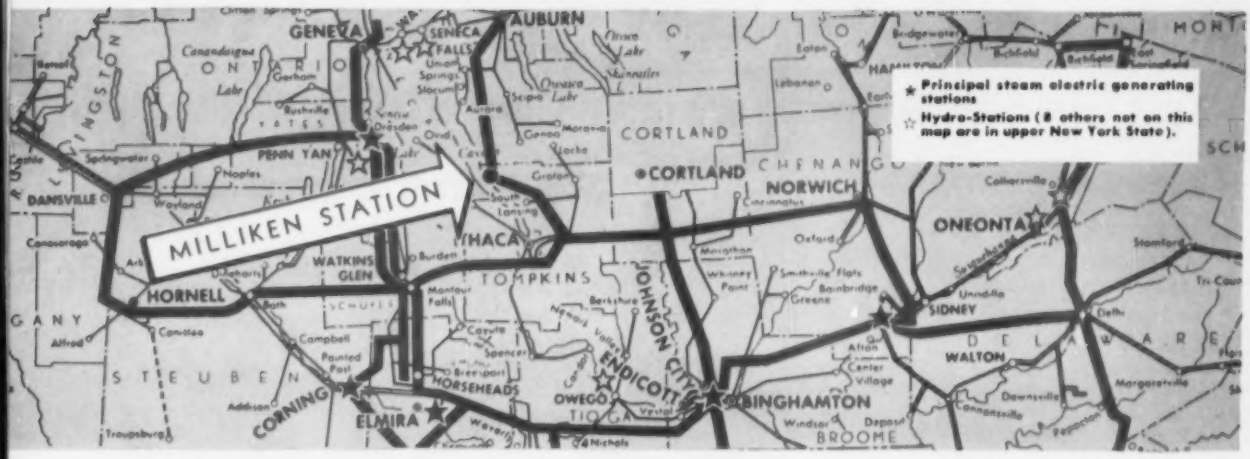


Three Elliott hydraulic turbine-driven generators—one 8750 kva, and two 5000 kva—are serving the High Falls Hydro Station of the New York State Electric and Gas system.



The two Elliott 350-hp, 300-rpm vertical induction motors, seen above, drive the circulating pumps handling lake water at the Milliken Station.

Three Elliott 2000-hp, two-pole "super-quiet" induction motors, left, are driving the Milliken Station boiler-feed pumps.



Elliott Motors, Motor-Generators, Deaerating Heaters, Condensers and Twin Strainers have been used in various stations of New York State Electric & Gas System for many years.

Now, Elliott equipment is serving the Milliken Station

Back in 1852, eight men subscribed $75,000 as initial capital to incorporate a gas light company in Ithaca, New York. Today, as the New York State Electric & Gas Corporation, this aggressive company has more than 15,000 stockholders and a capital investment of over $330,000,000. Before the new Milliken Station was added last year, there were already five principal steam electric generating stations and 13 hydro-stations and the company was serving 35 per cent of the New York State area.

Selecting dependable steam and electrical equipment for an expanding organization of this type is vitally important. In this case, Elliott products previously installed in the company's various stations had already proven their dependability. Once again Elliott equipment was selected. The same thing has happened all over the country—again and again, *consistent, trouble-free performance has led to repeat orders.* For descriptive literature, call your nearest Elliott District Office or write Elliott Company, Jeannette, Pa.

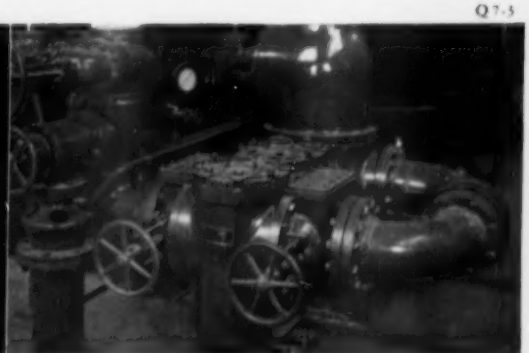
ELLIOTT Company

Steam Turbines • Motors • Generators • Deaerating Heaters • Ejectors • Condensers • Centrifugal Compressors • Turbochargers • Tube Cleaners • Strainers

Q7-5

An Elliott 210,000-lb-per-hr deaerating heater in the Greenridge Station, which has a vertical heater mounted on top of a horizontal storage tank.

An Elliott 27,000-sq ft divided water-box surface condenser, seen above, serves the No. 7 turbine in the Goudey Station.

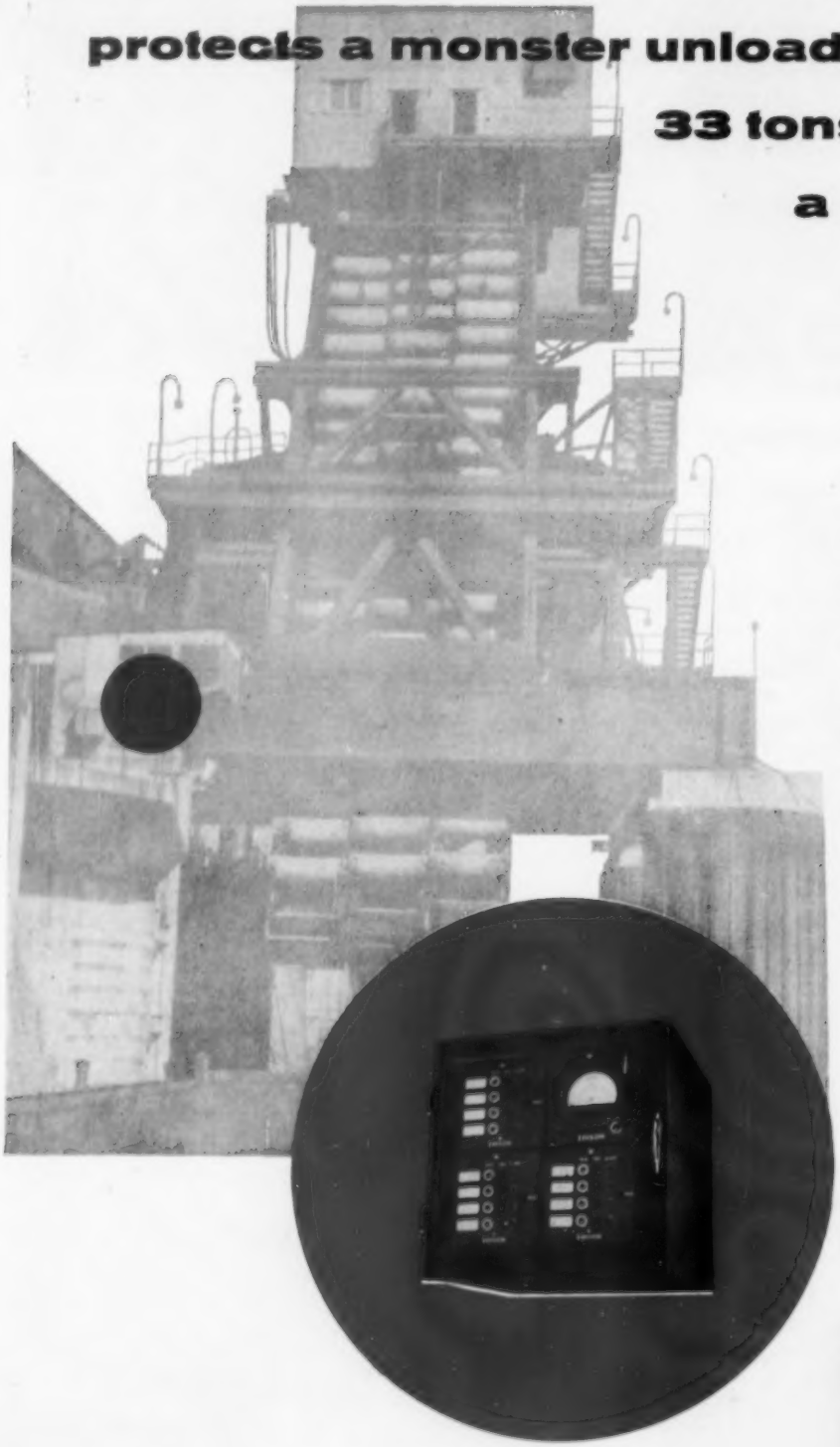


Installed in the suction line to a gasoline-engine-driven fire pump at Milliken is this Elliott 8-in. twin strainer.

For more data circle 501 on Post Card

EDISON'S OMNIGUARD

protects a monster unloading 33 tons of coal a minute



System monitors drive-shaft bearing temperatures

The monster is a bucket elevator . . . it unloads 32,000 tons of raw coal in 16 hours. Minute after minute, it raises 33 tons 76 feet straight up . . . subjecting the entire structure to severe stresses, shocks, and vibrations. Installing a monitoring system was considered a tough instrumentation problem before Edison was consulted.

Edison's **Omniguard** literally thrives on abuse of this sort. Its reliable electro-mechanical components, interchangeability, copper connecting wiring and modular construction make the **Omniguard** the most flexible temperature monitor available.

An **Omniguard** control panel was installed in the control house . . . far removed from the bearings at the top of the elevator. Edison Resistance Temperature Detectors were imbedded in the housings of the drive-shaft bearings . . . ready to signal a warning of dangerous temperatures to the **Omniguard** control panel.

The **Omniguard** system tamed the monster . . . provided uninterrupted elevator operation . . . and eliminated the possibility of interrupting the supply of coal to the furnace.

You can purchase a complete Omniguard system for less than $500. If you are interested in an economical, dependable, and efficient monitoring system, call Edison now for the full story. Or write for the Edison Folder No. 3036A.

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ENGINEERS' PREVIEW

NEXT ISSUE of POWER ENGINEERING you see will bear a new address, at the top of the left-hand column. For some time we have been planning to move into a new building. That building, located in Barrington, Illinois, about 32 miles northwest of Chicago, has been specially designed and built to accommodate the operations of Technical Publishing Co's three companion magazines: POWER ENGINEERING, *Plant Engineering* and *Atomics*, with space for further expansion.

According to present plans, we expect to move our entire staff into the new building on or about July 4. We will still maintain a contact office and telephone in Chicago, to be announced later. But after about July 4, our new address will be:

POWER ENGINEERING
308 East James Street
Barrington, Illinois

Picture of our new quarters, photographed while still under construction, is shown below. A view of completed building will be published in an early issue.

BY THIS TIME, all you power engineers who are camera fans have probably heard about the Kalfax process on which development work is being done. If you haven't, this will interest you because it involves an application of heat. The process, as reported recently in an AP dispatch, is a new system of photography that develops by heat rather than by chemical processing.

It involves a new film or paper which, it is claimed, may be exposed to light in a modified conventional camera to form a latent image. The paper or film is then heated to develop and fix the image in a matter of seconds.

As you can readily see, if this system can be worked out practically and economically, it will have a tremendous effect on the entire photographic industry, and especially on the applications of photography in industry.

WORLD'S FIRST Solar Energy Center, to conduct experiments in the use of the sun's power, will be built at Tierra del Sol, Calif., according to J. Y. Leveque, sponsor of the new project. Initial construction is slated to begin in the next few weeks, Leveque said.

It will be privately financed, and will aim at obtaining research and developmental contracts from government agencies and industrial firms.

The townsite, owned by Leveque, was formerly known as Hipass, California. Six months ago, the town was renamed Tierra del Sol — Land of the Sun — because of the nature of the new project.

Leveque, a San Diego and Los Angeles management consultant specializing in the aircraft and oil industries, undertook the new venture with the backing of eastern businessmen. A solar furnace capable of reaching temperatures in excess of 6,000 F, will eventually be built for the project. It will be used for test-

Construction view of Technical Publishing Co's new office building in Barrington

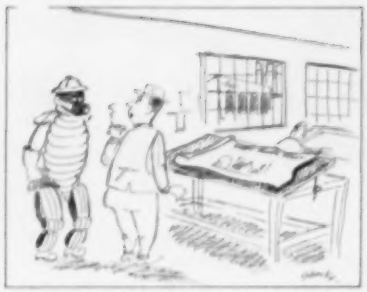
ing and heat-treating functions of value to the military and to industry.

In addition, a model home will be built, using solar energy exclusively for heating and hot water, and street lights will be equipped with solar batteries. A solar pump, to be imported from Italy, will be installed on a new well about to be drilled.

One of the first projects to be undertaken, Leveque said, will be research in the application of solar energy as a means of sea water conversion. Sea water will be shipped by rail from San Diego to Tierra del Sol for this purpose.

FOR A LONG TIME it has been obvious to industrial administrators as well as to engineers, that an important factor in the much-talked-about shortage of engineers is a correlary shortage in the supply of both technicians and skilled craftsmen. As one method of helping young people get into various technical fields in which the work of the technician and the craftsman are just as vital as those of the engineer, and in some cases more so, the National Association of Manufacturers has just published two interesting booklets. One of these is entitled Your Opportunities in Industry as a Technician. It points out how an average of between five and seven of the well-trained technicians are needed right now for every one professional engineer, in all areas of industrial research development and production. It explains what the engineering technician does, how to become one, what the opportunities are in the various fields, and the common-sense steps to be taken in preparing for such a career.

In a similar booklet entitled Your Opportunities in Industry as a Skilled Craftsman, the NAM shows, with photographs, drawings, and text, six vital craft specialties in detail; millwright, tool-maker or die-maker, maintenance electrician, all-around machinist, pattern-maker, and draftsman. It indicates how the student can best prepare himself for these programs while still in high school, and points out the courses and special aptitudes required. The booklet points out that from three to six skilled craftsmen are needed for every one



"I don't think you've quite grasped atomic energy yet, Hoskins"

scientist and engineer on the Atomic Energy Team. Wood craftsmen, core makers, plumbers, steamfitters, welders, mechanics, glass blowers, electronic specialists, are in growing demand to help set up atomic plants, and in the machine shops associated with nuclear research. This is significant in view of the growing interest in nuclear matters, but the same types of craftsmen are also needed in the engineering field in general outside the nuclear field.

Both booklets can be obtained by writing to the Education Department, National Association of Manufacturers, 2 E 48th St, New York 17, N. Y.

ON THE SAME SITE where his father initiated the construction of the Company's second hydroelectric generating station in 1913, C. G. Wright, president of Otter Tail Power Co, broke ground May 1 to mark the start of construction of Otter Tail's newest steam-electric generating unit.

This new 53,500-kw generating unit addition to the company's Hoot Lake plant in Fergus Falls will have a generating capacity approximately seven times as great as the plant's present steam-electric unit and 50 times greater than the original 1060-kw hydroelectric unit. The new unit, scheduled to go on the line in the fall of 1959, will cost the company $10,500,000.

Today the largest boiler using North Dakota lignite has a rating of 250,000 lb of steam per hour. The boiler in the new plant is rated at 420,000 lb per hr and will be the first boiler unit to make use of reheat with North Dakota lignite as the source of fuel.

WE THOUGHT we had heard of everything, and seen everything, but here's a new one on us — stretchable paper. For years we have heard editors, their hands clutching what few spears of hair they have left, and their curses ringing the welkin, cry to high heaven, "Oh, for some rubber type!" when they are trying to get 39 characters into a line that only sets 36 in type.

This stretchable paper is designed to produce flush right-hand margins on typewritten copy with only one typing. If you type the copy short of full measure, it says here, you simply stretch the paper to produce even right-hand margins. It doesn't say here what this does to the widths or height of the letters, although it does claim that any distortion is negligible. Hah!!! This we gotta see!

THE HORIZON FOR POWER gets wider and wider. Both Westinghouse and General Electric have lately peered with a knowing eye into the years that lie just ahead. Results: Westinghouse's A. C. Monteith, vice president in charge of apparatus products, sees 450,000,000,000 kwh of electrical power needed by American industry in 1963. This is a 12½ per cent increase over a 10-year forecast made three years ago.

Glenn B. Warren, vice president of GE's turbine division, says that over the next 10 years the electrical power generating industry will put in place as much generating capacity as was built in the past 75 years. By 1977, Warren predicts, the installed kw capability and peak loads met will be some 625,000,000 kw.

CORRECTION NOTE: — In the article How To Size An Exhaust Hood, page 89, POWER ENGINEERING, May 1957 issue, the correct formula on which the graph is based is the one given in line 3, column 3, of the text material. That reads, correctly: Q = 1.4 VPD. P in that equation was originally given as "perimeter of hood face in feet." This should have been given by the author as: "P is perimeter of source of heat and fumes" in both text and drawing. Please mark your copy accordingly. Our editorial face is very red.

DE LAVAL
OPPELLER PUMPS

last longer... cut maintenance costs

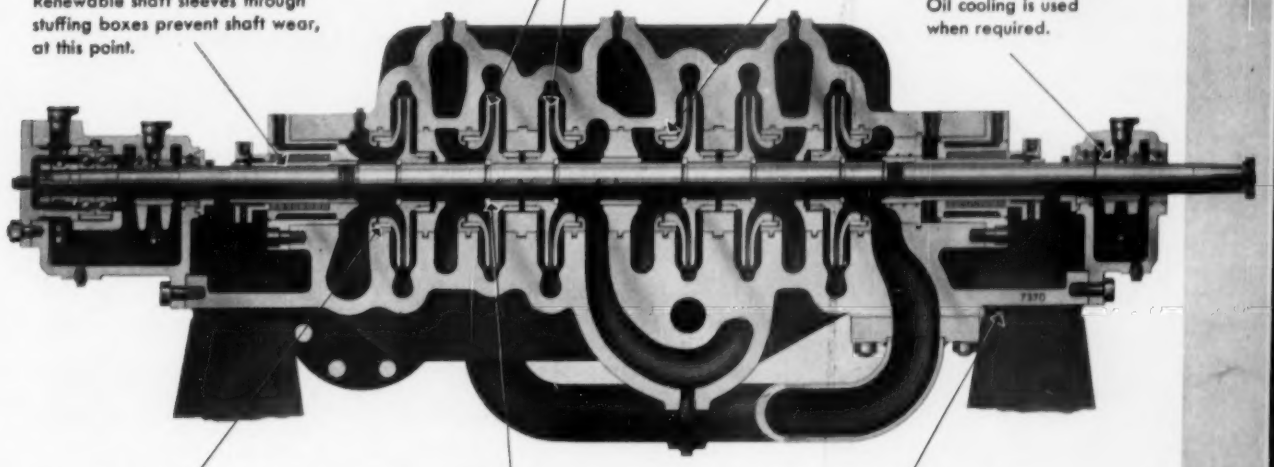
Stages are arranged to reduce differential pressures between stages. This insures permanent sealing at the casing-joint and at interstage diaphragms.

Pairs of back-to-back impellers balance axial thrust. One-purpose thrust bearing carries no radial load, maintains axial alignment.

Labyrinth wearing rings permit safe clearances and reduce wear.

All bearings are ring-oiled, sealed against contamination by water or dust. Oil cooling is used when required.

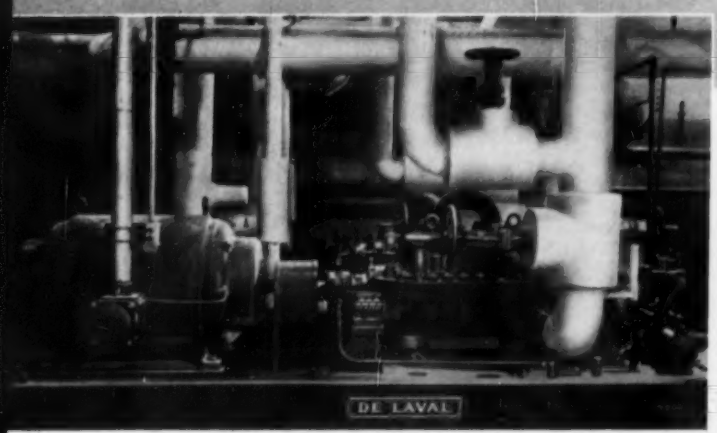
Renewable shaft sleeves through stuffing boxes prevent shaft wear, at this point.



Threaded impeller wearing rings make replacement easy without heating or damage to impellers.

Individual impeller mountings, with split locating rings, make interstage shaft sleeves unnecessary. Impellers can't shift with shaft expansion and contraction.

Casing support insures coupling alignment at any operating temperature.



Here are two De Laval 6-stage Oppeller Pumps used for boiler feed service in an industrial installation.

The design features above show clearly why De Laval Oppeller Pumps stay on the line longer and cost less to maintain. These pumps are used for boiler feed, hydraulic systems, descaling spray, mine dewatering, refinery oil pumping and similar services.

De Laval Oppeller Pumps are available in sizes from 2 to 4 inches and 2 to 8 stages; capacities to 1000 gpm, pressures to 1200 psig and temperatures to 350F.

DE LAVAL *Oppeller Pumps*

DE LAVAL STEAM TURBINE COMPANY

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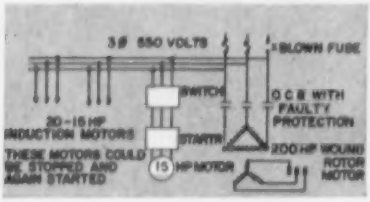
WHAT THEY TELL US

▶ **READER LLOYD MCWILLIAMS** of Shawinigan South, Quebec, Canada, on reading the article Single-Phasing . . . What It Is, What to Do About It, by G. W. Heumann, POWER ENGINEERING, March 1957, page 74, was reminded of one of his own experiences with single-phasing. He writes:

> That article brings to mind a somewhat unusual experience with single-phasing some years back, which may be of interest to readers. Usually, a single-phase condition is fairly apparent when checks are made with proper instruments; however, the case here described had the shift electricians baffled for nearly two weeks. The reason was that they used pocket-type vibrating voltage testers of the "jigger" type, which are quite unreliable for true values of voltage.
>
> Referring to my sketch, we had a 200-hp, wound-rotor motor driving an exhaust fan, on continuous duty. One fuse had blown at X. (This, of course, was learned later). An unfused circuit with twenty 15-hp induction motors was tapped off the load side of the large fuses for the 200-hp motor. (A hay-wire hookup, but not unusual on construction jobs).
>
> The dash-pot type overload feature on the breaker was faulty, with the result that the 200-hp motor kept running single-phase. The 15-hp motors could be stopped and started at will; however, there was rather heavy flashing at the magnetic switch contacts.
>
> The electricians suspected something was amiss because fuses were blowing on the 15-hp motor circuits. They, of course, over-fused to keep things moving. Their tester indicated that they had three-phase voltage.
>
> Finally, it was only after a proper check with a clip-on ammeter and voltmeter that the unbalance, mentioned by Mr. Heumann, was detected and the difficulty traced to its source.



This caused the single-phasing that baffled electricians until they checked the circuits with proper instruments

▶ **FROM KEY WEST,** Fla., reader D. I. Calleja of that city's electric system, comments drily that in this period of changes in the heavy oil situation (due to the Suez situation) many people will have to burn just about anything that will flow through a pipe. This may lead to troubles.

Calleja reports that with his last shipment of Bunker C oil, he began to have trouble with smoking, high air and gas temperatures, and lots of complaints from the public and from city officials.

The plant had been given its yearly once-over not more than three weeks before all this began, so Calleja knew he had a special problem on his hands. Readings were as follows: 63,000 lb per hr steam flow; 64,000 lb per hr air flow; gases to air heater, 780 F; air from air heater, 520 F; gases from air heater, 470 F; Btu per net kwh, 15,245.

One boiler was taken off the line and it was found that the boiler tubes had so much soot on them that it was even obstructing the gas passage to the stack, and acting as tube insulator. Fuel oil was tested and showed an enormous increase in sulfur and vanadium oxide.

It was decided to clean the tubes by hand-lancing. This is how Calleja did it:

Safety precautions were taken first, such as enough coverall, gloves, head hoods, glasses, petroleum jelly for face and hands, fully-equipped first aid kit and resuscitator, also a standby man. Other equipment included one empty 55-gal oil drum, two small Viking-type pumps, plastic garden hoses, a few 50-lb bags of lime, a chemical-mixing pump, and tube-scraping tools.

The drum was filled with 53 gal of water from the system's condensate tank, which would dissolve 75 lb of lime quickly and also have fewer impurities. At the bottom of the soot box a drain was installed to allow the lime wash to drain out. One of the pumps was used to water-wash the tubes, and the other was used to supply water to the drum from the condensate tank.

Water and lime were continuously added while the man washed inside the boiler, also using scraping tools. When this job was finished, the tubes looked like new.

Boiler was put back on the line and the tube temperature kept between 800 and 875 F while bringing up steam. Improvement was noted at once. Readings were as follows: electric generation, 5800 kw; 60,000 lb per hr steam flow; 60,000 lb per hr air flow; gases to air heater, 630 F; air from air heater, 448 F; gases from air heater, 365 F; Btu per net kwh, 14,500.

To keep the tubes clean, Calleja has had to change the operation of the soot blowers, soot now being blown every 4 hr instead of once a day. He has also worked out an arrangement to air-lance the tubes every week, connecting a long tube to house-air, with pressure of 150 psi. He advises first putting the ID fan on manual control and increasing the air, if possible keeping the same load, under close watch by the fireman.

▶ **READER ROY R. ROBINSON,** city manager, City of Kinston, N. C., recently requested a copy of that beautiful Sargent & Lundy brochure noted on page 3 of the April issue. He also commented:

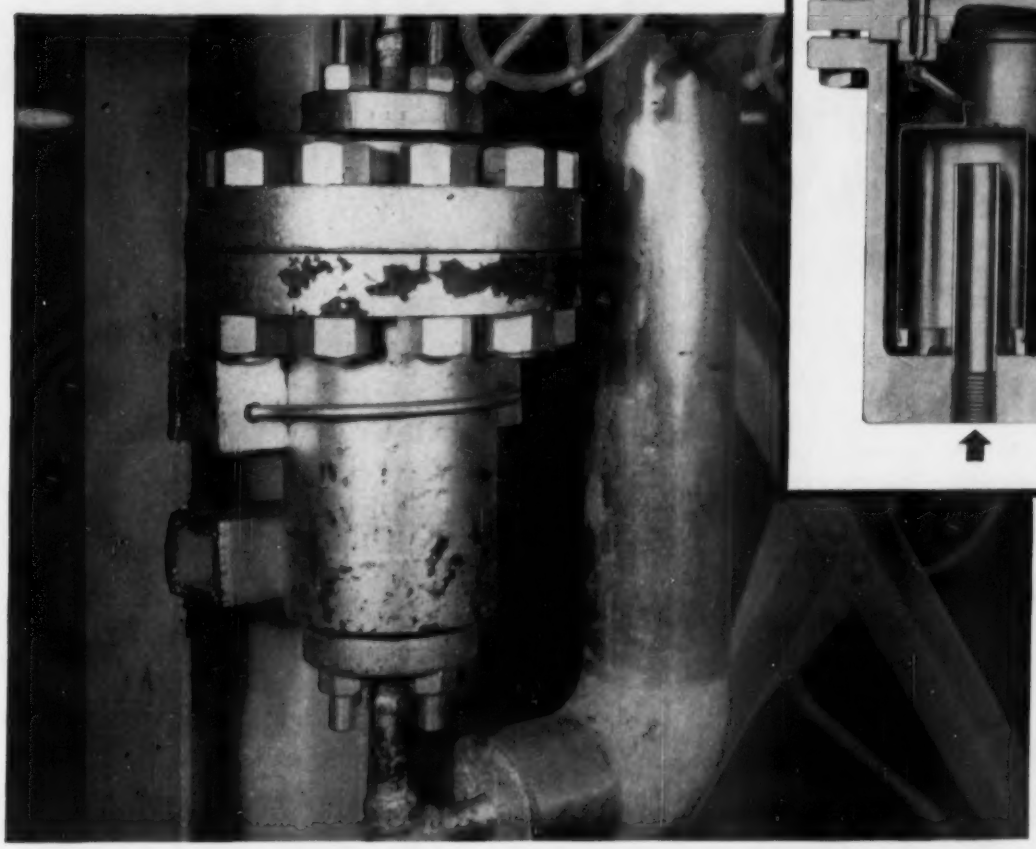
> In the same issue was an article (page 87) on a Florida sewage station using a flag pole for a gas vent. Some 20 years ago, the City of Charlevoix, Mich., built a sewage disposal plant in the center of the business district on lake shore. That plant has the operating building over the settling tanks and digester alongside. An ornamental flag pole which is in front, is the gas vent from the operation; and the casual observer would have no idea as to the use of the building.

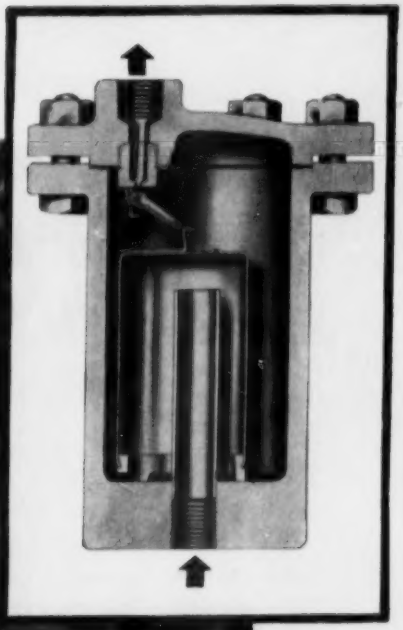
▶ **WHAT HAPPENS IN WISCONSIN** has repercussions of interest as far away as Hungary. Lorânt Kuti, a mechanical engineer living in Budapest, asks us for more information on aluminum used for condenser tubing, as reported by POWER ENGINEERING in connection with the Oak Creek power station of the Wisconsin Electric Power Co.

Kuti wanted to know more about the percentage composition of the aluminum alloy, the cooling water used in the condenser, electrolytic corrosion, and operating experience with this kind of condenser tubing. On these points, W. A. Pollock of Wisconsin Electric and R. A. Wilson of the Allis-Chalmers Mfg. Co. passed along these facts:

> Percentage composition of tube alloy is given by the aluminum company's designation number. At Oak Creek, condensers 1 and 2 were tubed with *continued on page 92*

ARMSTRONG FORGED STEEL STEAM TRAPS . . .





. . . the Best Answer to Superheated Steam Line Drainage, because:

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Part	Material
CAP AND BODY FORGINGS	
Up to 600 psi, 750°	1030 carbon steel
Up to 900 psi, 900°	ASTM Spec. F-1 carbon moly steel
Up to 2500 psi, above 900°	ASTM Spec. F-5 chrome moly steel
VALVE AND SEAT	Type 440 chrome steel, heat treated, standard. Stellite available.
LEVER MECHANISM	Stainless steel
BUCKET	Stainless steel
BOLTS	Class C high tensile, high temperature bolting material — 125,000 min. tensile.
NUTS	Hex, semi-finish, heat treated for high pressure, high temperature service.
GASKET	Compressed graphited asbestos
INLET TUBE	Wrought iron

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2. **Experience** of Armstrong in design, manufacture and application dates back to the *beginning* of the trend to higher and higher pressures.
3. **Automatic** safety assured because of high capacity for warm-up loads; traps don't "forget" to drain the lines, and Armstrong traps *always* open for condensate.
4. **Economy** assured because of high value for price, long life with infrequent maintenance and freedom from steam loss.
5. **Quality** of workmanship and materials that is backed by a "complete satisfaction or your money back" guarantee.

SEND FOR THIS LITERATURE:

1. Should we trap superheated steam lines? — the answers of 11 engineers who have used traps for this service.

2. Catalog J — complete data on forged steel traps and steam trapping.

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STEAM TRAPS

ARMSTRONG MACHINE WORKS, 8107 Maple Street, Three Rivers, Michigan

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Are they drop-tight? Rugged and dependable? Easy to maintain?

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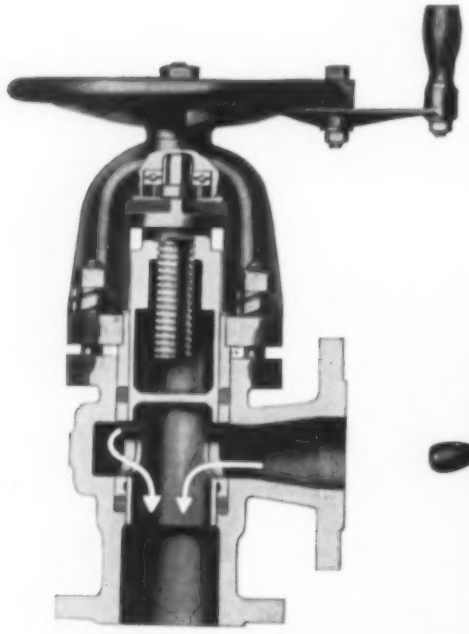
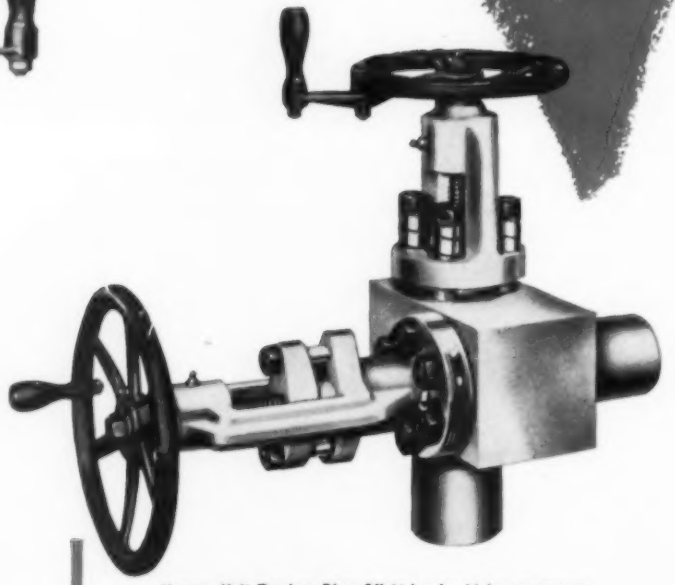
Old YARWAY Blow-Off Valves also can be overhauled and modernized, because all YARWAY improvements are *interchangeable* with parts on earlier models.

Write today for YARWAY Blow-Off Valve CHECK SHEET—also new YARWAY Blow-Off Valve Catalog B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).



Yarway Seatless valve for low and medium pressures. Features balanced nitralloy plunger that seals line drop tight—yet permits free, unobstructed flow in blow-down. **Used in over 15,000 boiler plants.**



Yarway Unit Tandem Blow-Off Valve for higher pressures. Combines Yarway Seatless Valve and Yarway Hard-Seat Valve, or two Yarway Hard Seat Valves, in a one-piece forged steel body. For years—the choice of 4 out of 5 high pressure power plants.

YARWAY steam

✓ WHAT ABOUT WATER COLUMNS AND GAGES?

Are they in good working order? Are they up-to-date?

If your boiler pressures are over 900 psi, have you considered the advantages of the new YARWAY COLOR-PORT Gage? It offers brilliant two-color (red and green) readings, greatly reduced maintenance, increased availability and longer service life.

Write for full details in Bulletin WG-1814.

✓ HOW ABOUT ADDING NEW REMOTE LEVEL INDICATORS?

Remote readings of boiler water level at any spot in the plant are a recognized convenience —and easy with "Wide Vision" YARWAY Remote Liquid Level Indicators.

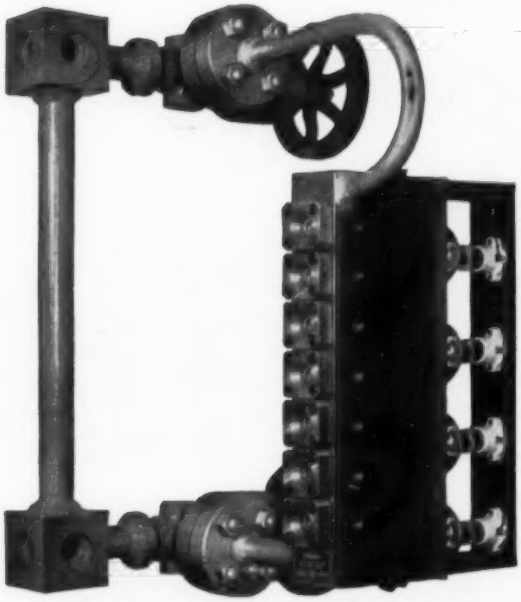
Because the indicating mechanism is operated by the boiler water itself, response is always instant, readings always accurate.

YARWAY Hi-Lo Graph Recorder not only gives remote indication but also a 24-hour recording of water levels.

YARWAY Remote Indicators and Recorders can also be supplemented with Remote Hi-Lo Alarm Signals—light or horn.

Write for Catalog WG-1824.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



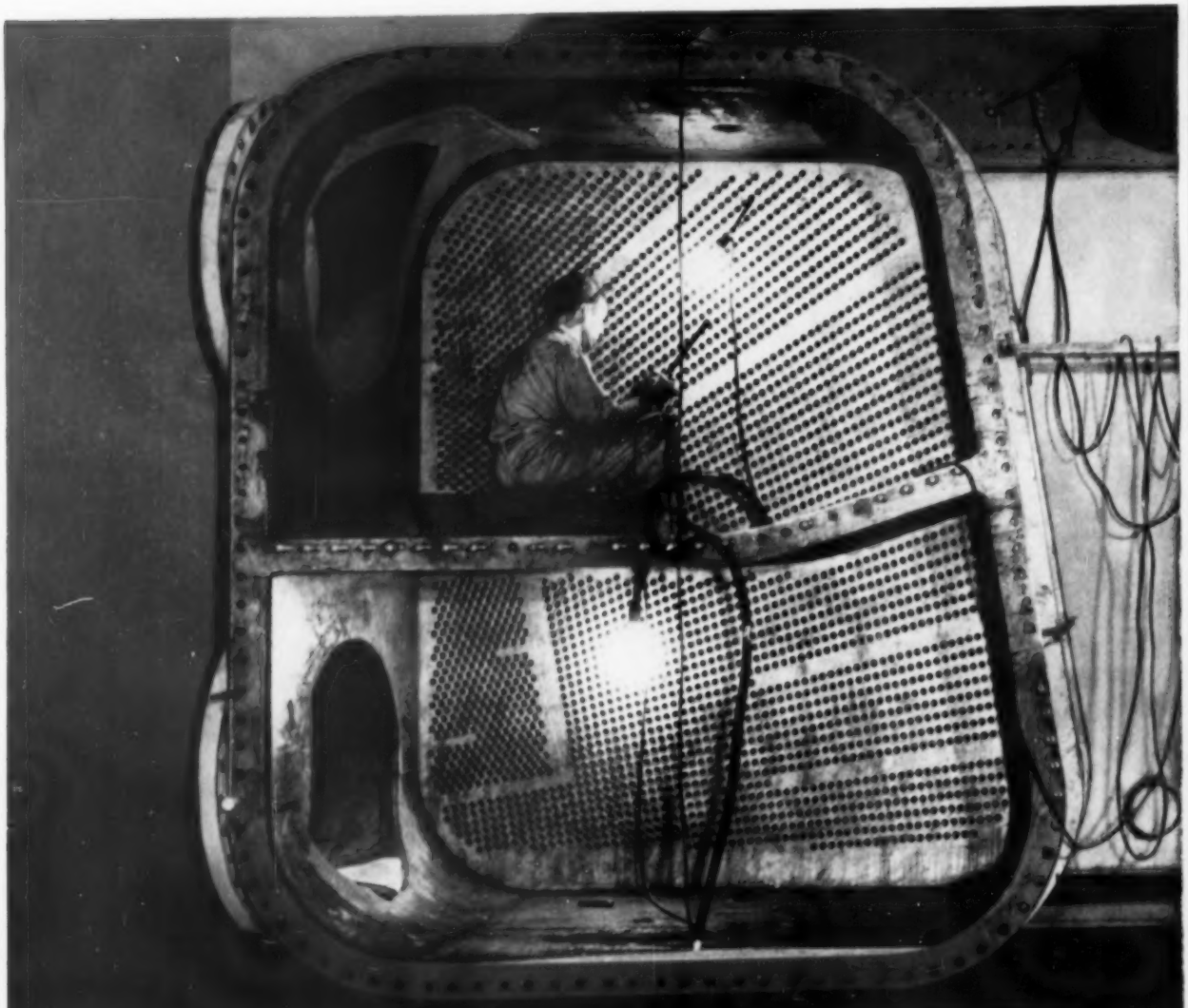
Side view of new Yarway Color-Port Water Level Gage with illuminator, circulating tie-bar and Welbond gage valves. Water space shows green in the gage; steam space shows red.

Yarway Remote Liquid Level Indicator with "wide vision" face. Manometric type with automatic temperature compensation where required. Over 10,000 used throughout industry.

plant equipment

For more data circle 505 on Post Card

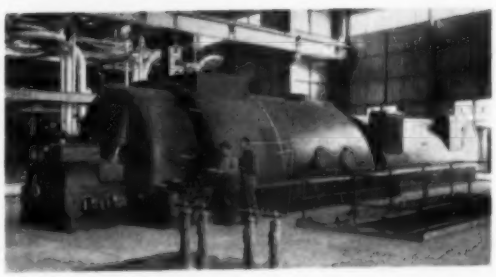
Bridgeport tubes fight "Coastline Corrosion" in Indiana



LARGEST ALUMINUM BRONZE CONDENSER TUBE

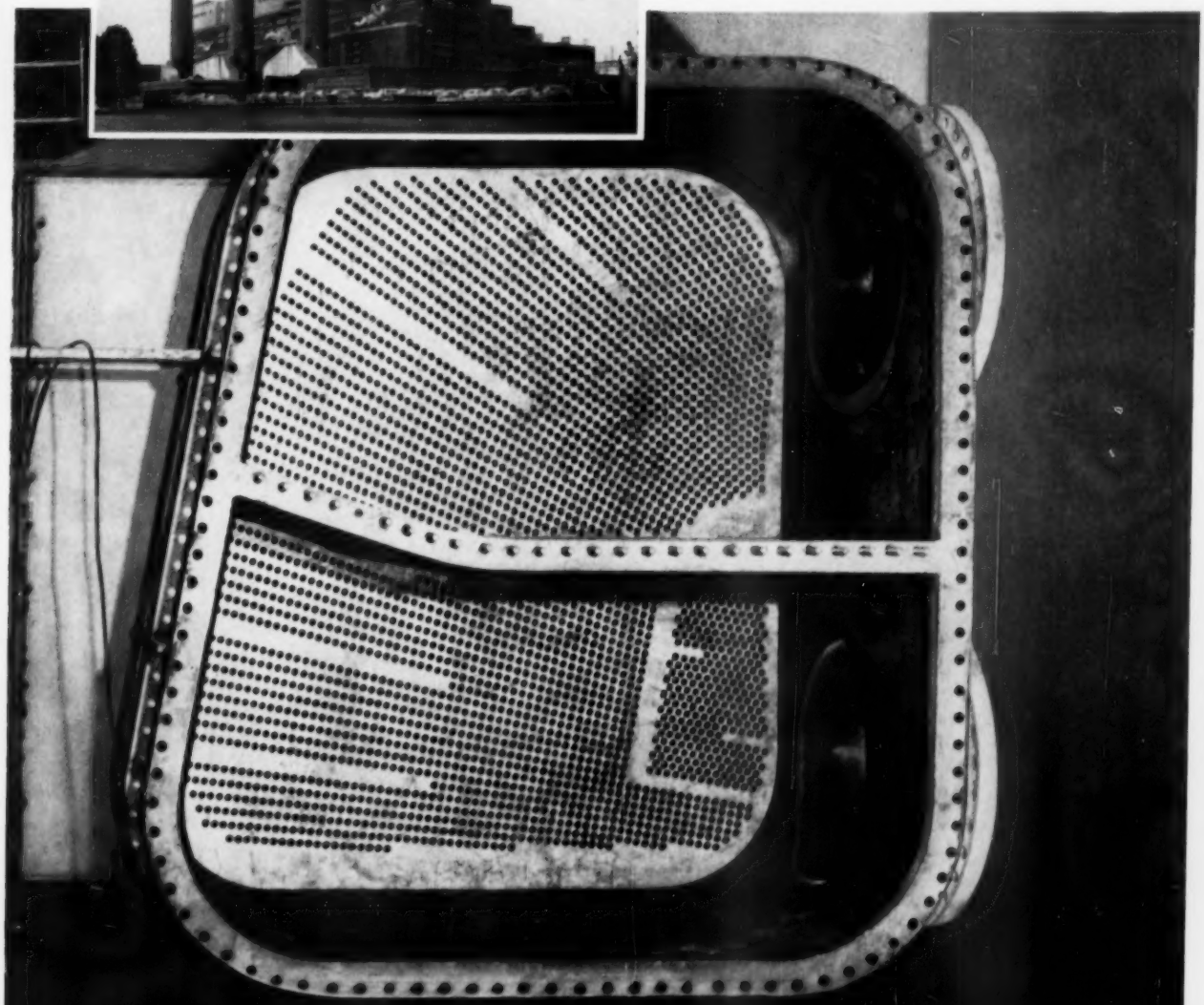
Above: Bridgeport Duronze condenser tubes are being rolled into Unit 6's condenser. The completed installation required 6,420 pieces (104,834 lbs.) of Duronze IV (Aluminum Bronze) 1" OD x .049" x 30'.

Of the six turbogenerators, the latest is approximately 61 ft. long and 17 ft. wide, uses 1,000°F. steam under 1,535 lbs. pressure. The tips of its longest blades move at a speed of 852 miles per hour—faster than the speed of sound.



Bridgeport Brass Company, Bridgeport 2, Conn. • Offices in Principal Cities • In Canada: Noranda Copper and Brass Limited, Montreal

H. T. Pritchard Power Station, located 18 miles southwest of Indianapolis, is the newest and largest of the five power plants of Indianapolis Power & Light Company. At full capacity, it generates 376,000 kws, burning about 3,000 tons of coal and using more than 325 million gallons of condensing water per day. Designed in 1946 for four generating units, it has been expanded to six units at a total cost of $51 million. All six are equipped with Bridgeport condenser tubes.



INSTALLATION IN ANY INLAND POWER STATION

Unit 6, latest and largest generating facility at Indianapolis Power & Light Company's H.T. Pritchard Station, has a capacity of 105,000 kw. Its giant 50,000 sq. ft. Lummus condenser contains 192,600 feet of Bridgeport Duronze IV (Aluminum Bronze) condenser tube.

The selection of Duronze for Unit 6 is a story of special interest to power engineers. It is the result of more than ten years of continuous cooperative research and record keeping by Indianapolis Power & Light's engineering staff, their consultants, Gibbs & Hill, and Bridgeport's Corrosion Laboratory. Another close-by station on the same river served as the experimental "testing ground" on which to observe the performance of various condenser tube alloys, including Admiralty and Aluminum Brass. It was this careful preliminary work that led to the choice of Duronze despite its $13,000 higher initial cost.

Although Aluminum Bronze (Duronze IV) is usually associated with seaboard station installations, White River's use of this alloy in such quantity shows how complete and constant cooperation—in all phases of research and testing—combined to permit dependable planning. It serves, too, to prove that working closely with Bridgeport produces *success-in-service* operation.

You can benefit from Bridgeport's experience and cooperation on condenser tube applications. For prompt service, call or write the Bridgeport Sales Office nearest you.

BRIDGEPORT CONDENSER TUBES

BRASS Bridgeport CO

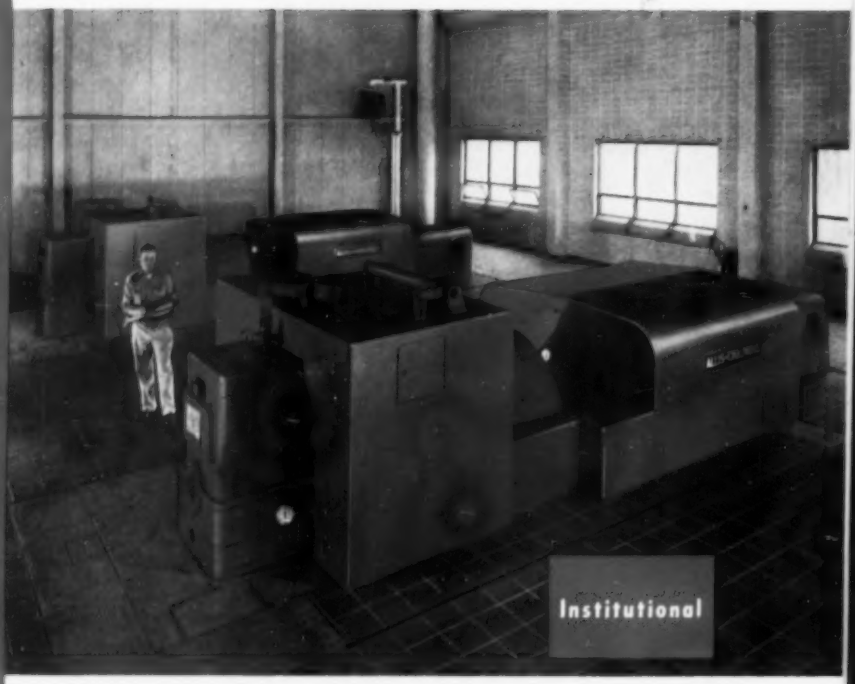
For more data circle 506 on Post Card

ALLIS-CHALMERS STEAM

The Choice of

ONE OF THREE Allis-Chalmers steam turbine generator units in a large brewery. This 5000-kw condensing, automatic extraction, impulse unit generates electricity as a by-product of process steam.

A MINNESOTA CITY supplies business district and residential heating steam, and electric power with this recently installed 7500-kw condensing, automatic extraction steam turbine generator unit.



LARGE QUANTITIES of steam are required for heating, laundry, and other services. These 3000-kw Allis-Chalmers non-condensing, automatic extraction turbine-generator units supply steam at two pressures as well as electric power.

THIS 5000-kw condensing steam turbine generator unit was designed to meet the special requirements of a nuclear power plant. In addition, Allis-Chalmers supplied the switchgear, condenser, pumps, motors and other auxiliaries.

TURBINE GENERATOR UNITS

Modern Power Plants

Condensing . . . non-condensing and automatic extraction units are available for wide range of services

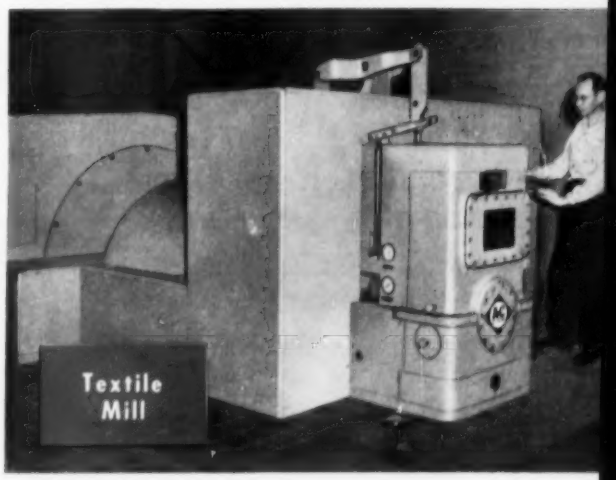
UTILITIES, breweries, textile mills, medical institutions, and a nuclear power plant enjoy the low installation and operating costs of Allis-Chalmers WA-Series steam turbine generator units.

These modern, compact units complement the most modern plant design. They are built in NEMA ratings through 10,000 kw . . . AIEE-ASME preferred ratings to and including 16,500 kw.

Users of these Allis-Chalmers turbines enjoy an important advantage. "Big turbine" features are incorporated in their design.

For example, the centrifugal-type speed governor is the same type used in large Allis-Chalmers steam turbines. Steam seals are the same labyrinth type used in turbines up to 300,000 kw. Removable external glands, high chrome alloy steel buckets and nozzles are other features. The 16,500-kw units with hydrogen-cooled generators have the same type of hydrogen seals as used on the large sizes.

Unit shipment with rotors individually locked in place cuts installation time and cost. Foundation cost is reduced because oil piping and generator air coolers are above the floor line.



PROCESS STEAM in a synthetic yarn plant produces electric power as a by-product with this 5000-kw non-condensing steam turbine generator unit.

GET MORE FACTS on these economical units. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

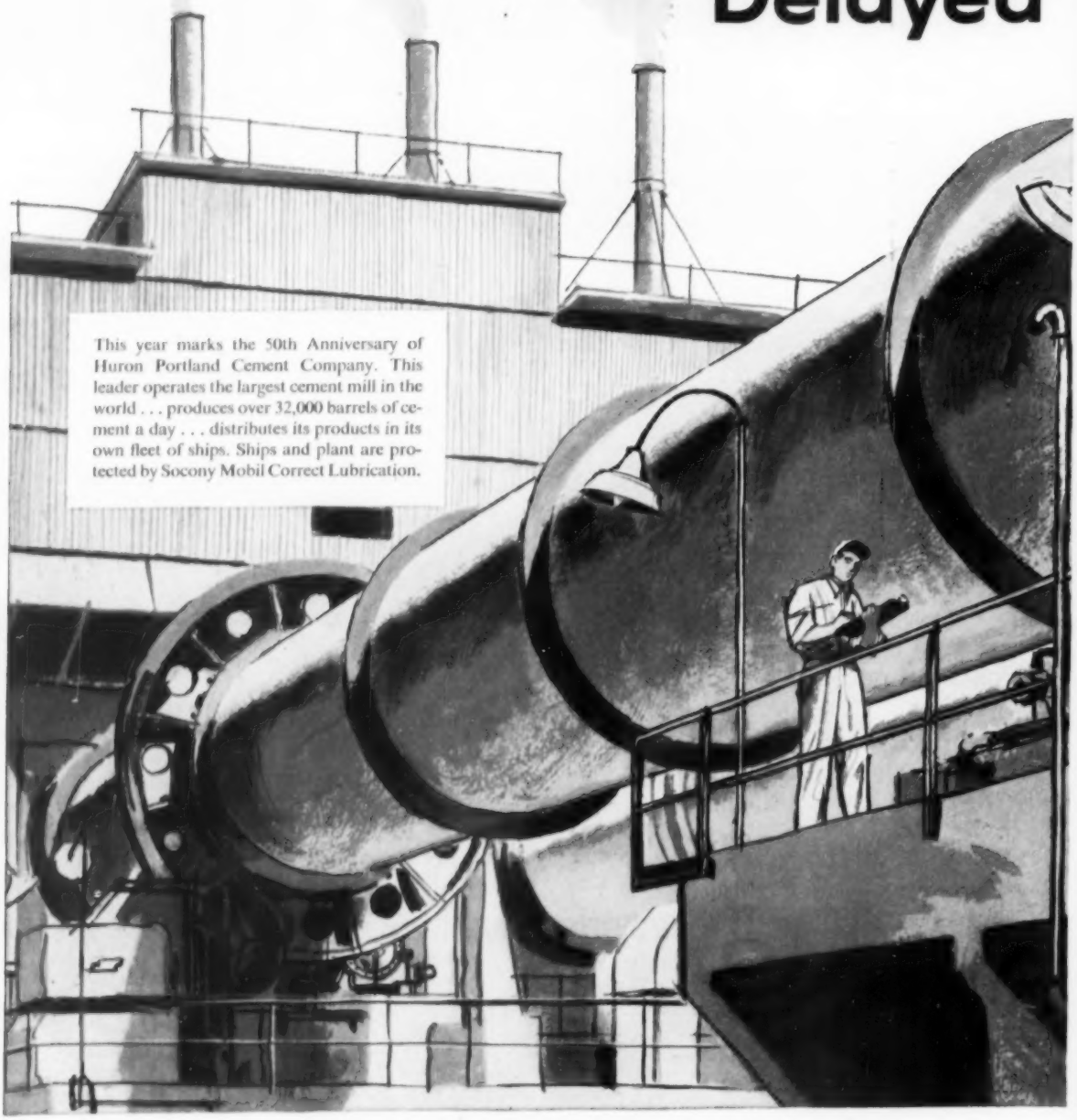
A-5437

ALLIS-CHALMERS

For more data circle 507 on Post Card

Correct Lubrication in Action...

Girth Gear Replacement—Delayed



This year marks the 50th Anniversary of Huron Portland Cement Company. This leader operates the largest cement mill in the world . . . produces over 32,000 barrels of cement a day . . . distributes its products in its own fleet of ships. Ships and plant are protected by Socony Mobil Correct Lubrication.

Mobil **SOCONY MOBIL**

Leader in Lubrication for over 91 years

in the **Cement Industry**

Expenditure of $8,800 Indefinitely !

One of many maintenance savings made by the Huron Portland Cement Company with the help of Socony Mobil

Located at Alpena, Michigan, is the world's largest single cement plant. To assure its continuous operation at minimum maintenance cost, Huron Portland Cement Company relies on a Socony Mobil Program of Correct Lubrication. Here's an example of this comprehensive service in action:

Problem: Pinion gears on four kilns were wearing excessively . . . so also were the huge girth gears. In time, girth-gear teeth became so roughened that new pinion gears would be quickly damaged when installed. How to avoid the costly job of replacing the girth gears was the problem facing the Company.

Solution: After consultation with Huron Portland personnel, Mobil engineers recommended a special Mobil lubricant compound that cut wear on pinion gears . . . at the same time helped smooth up the girth-gear teeth. Result—girth-gear life was extended indefinitely . . . $8,800 saved on just one kiln.

Service like this has helped this cement company continually improve profits through increased production . . . reduced maintenance costs. Perhaps it can do the same for your plant.

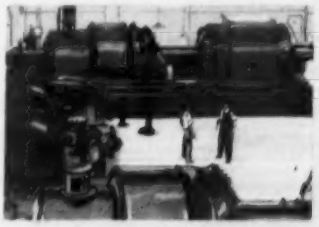
Other ways Mobil Correct Lubrication cut costs

Exceptionally long product life—4 Allis-Chalmers generators supply power for entire Huron Portland Cement plant. Same fill of Mobil D.T.E. oil has been in continuous use in one of these generators for over ten years. Units have not shut down once due to lubrication failure. In fact, latest samples show oil to be in "like new" condition . . . good for many more years.

Gear maintenance cost cut—Mobil engineers surveyed planetary-type gear sets that drive mills, kilns and other machinery. As a result, they recommended a single wide-range lubricant in place of three products formerly used. Qualities of this Mobil product eliminated periodic need to clean sludge from gear cases . . . extended oil fill life 100% . . . produced savings in storage and handling.

Engineering assistance cut downtime—Mobil engineers cooperated with Huron Portland in investigating cause of bearing and tooth failures on gear reducers. It was found that gears had been purchased from different suppliers and that tooth sizes varied. Mobil suggested purchasing new gears from one supplier. Mobil engineers also suggested that grooving in pressure area of split-bushing bearings be removed. When this was done, gear reducer trouble ceased . . . downtime was sharply cut.

Complete Mobil service—Supplying Huron Portland with top-quality lubricants is only a part of the comprehensive Mobil program. Mobil field personnel, engineers and sales representatives work closely with Huron Portland's maintenance personnel. They conduct in-plant training courses, make analyses of products in use, submit periodic reports on benefits achieved. No wonder records show a continual reduction in maintenance costs over the years.

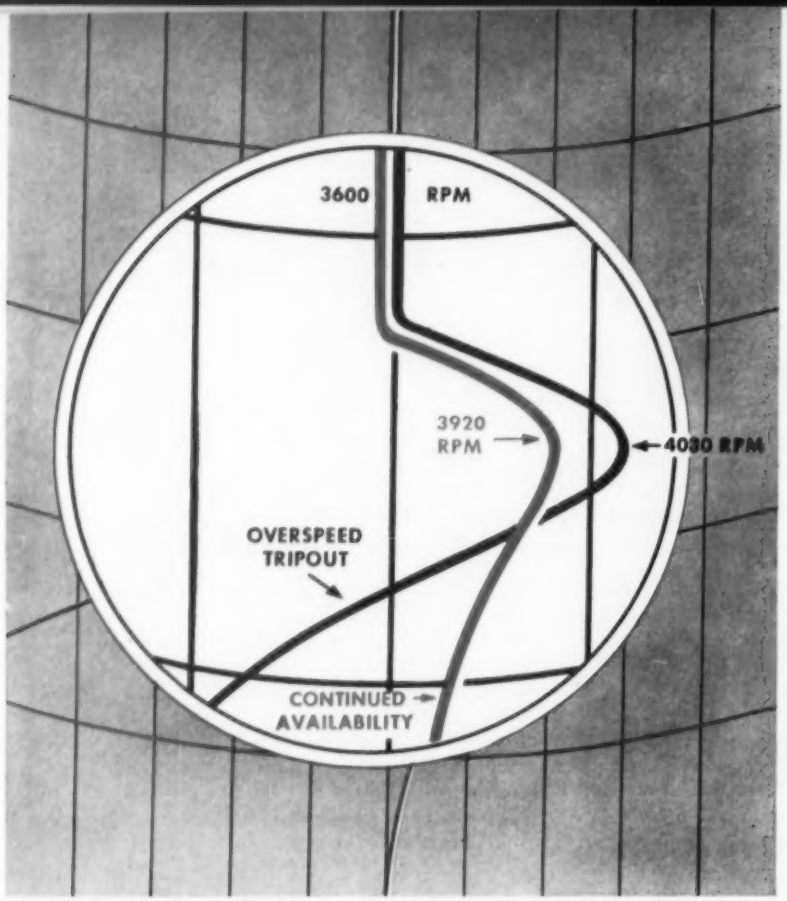


Correct Lubrication

A proved program to reduce maintenance costs

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

For more data circle 508 on Post Card

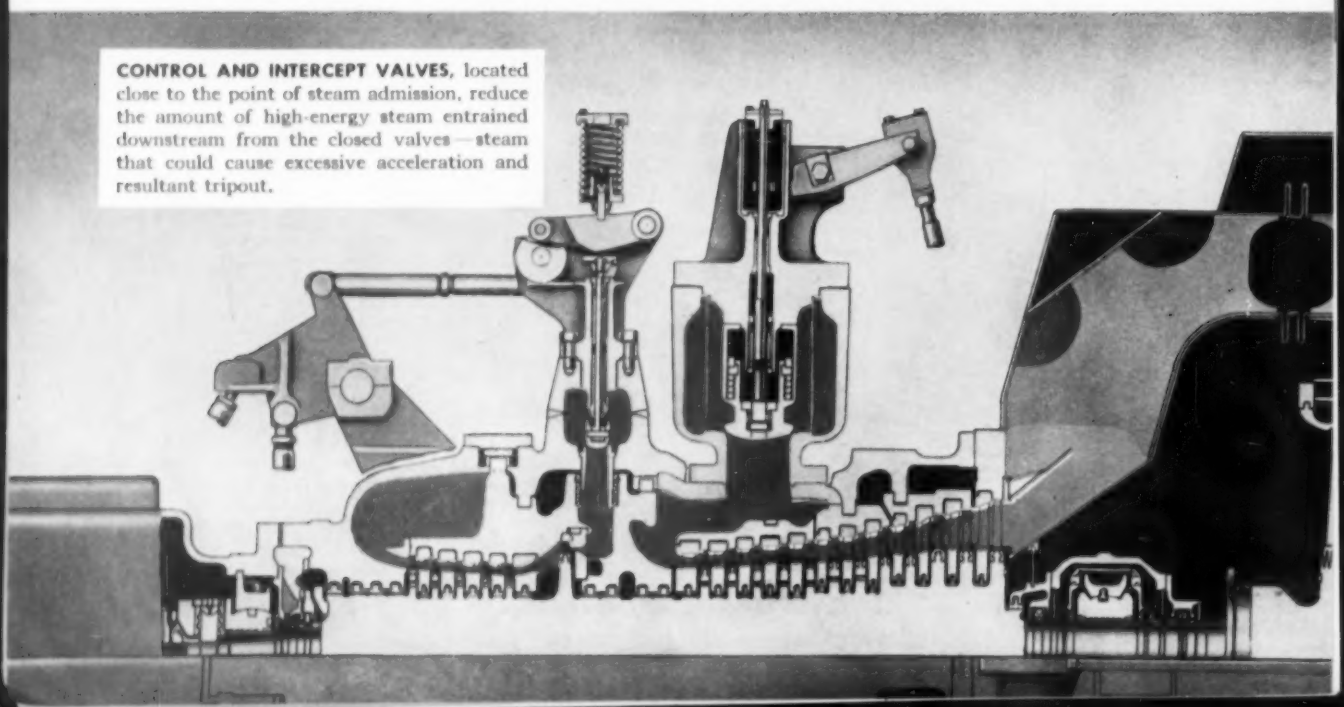


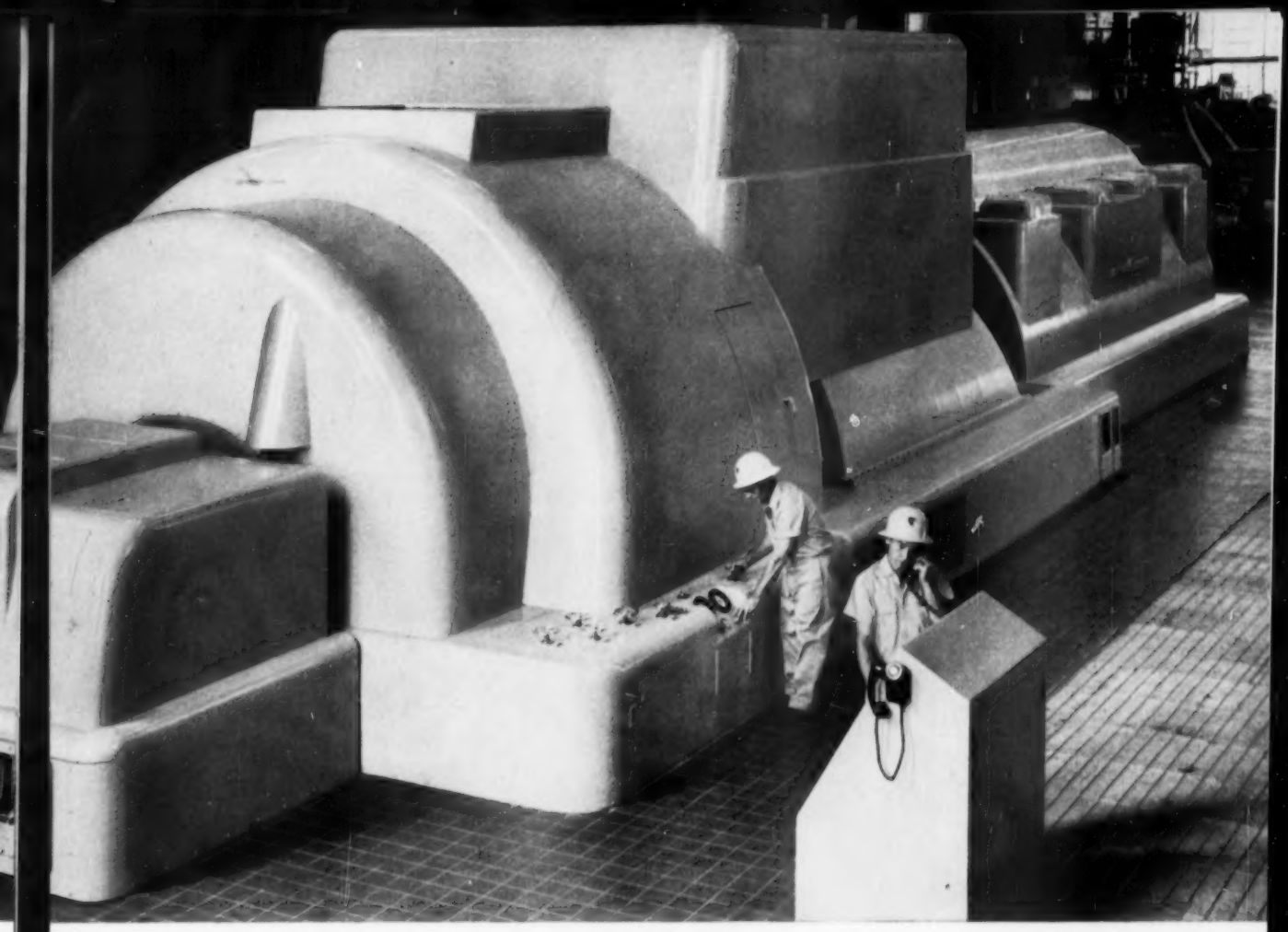
SENSITIVE GOVERNING SYSTEM helps avoid costly tripouts. The red curve, above, shows how a typical G-E reheat turbine stays below tripout speed by limiting speed to 3920 rpm during temporary system interruption. Without this split-second governing response, overspeed to 4030 rpm can result in costly shutdown.

SPLIT-SECOND RESPONSE to system disturbances helps keep units like this on-the-line. Pictured here is a 150,000 kw reheat steam turbine-generator at Oklahoma Gas and Electric Company's Riverbank Station.

Split-second response helps keep

CONTROL AND INTERCEPT VALVES, located close to the point of steam admission, reduce the amount of high-energy steam entrained downstream from the closed valves—steam that could cause excessive acceleration and resultant tripout.





General Electric turbines on-the-line

SENSITIVE GOVERNING SYSTEM COPES WITH TEMPORARY SYSTEM DISTURBANCES

Requirements for sensitive, faster-responding governing systems have steadily increased with the trend toward larger reheat turbines with their inherent high overspeed potential.

Modern turbines entrain significant quantities of high-energy steam downstream from control and intercept valves and in crossover pipes. Because this steam can cause rapid acceleration upon load loss, governing systems must instantly sense speed changes to ride through temporary system disturbances. A split-second time lag may mean the difference between tripout and continued turbine availability.

Locating control and intercept valves as close as possible to the turbine operating stages reduces the amount of high-energy steam trapped downstream from the valves. With the acceleration potential of this entrained steam kept to a minimum, overspeed is limited and the turbine remains on governor control despite temporary system interruptions.

Other refinements such as use of an extremely sensitive governor and relays help make fast response possible. This governor senses the slightest change in speed and transmits a signal to activate the governing system.

Sensitive response of governing systems is another example of how General Electric turbine research and engineering leadership combine to build tomorrow's turbine-generators today. For further information on reheat turbine overspeed protection, write for bulletin GER-920, Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York. 254-39

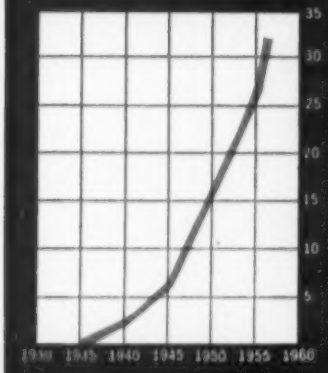
Progress Is Our Most Important Product

GENERAL ELECTRIC

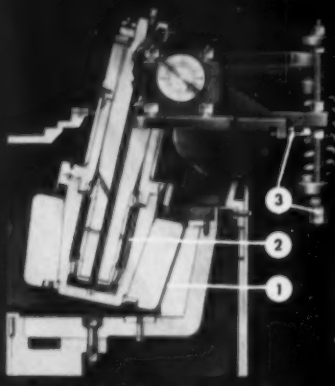
For more data circle 509 on Post Card

Why the Bowl Mill is

AMERICA'S No. 1 PULVERIZER

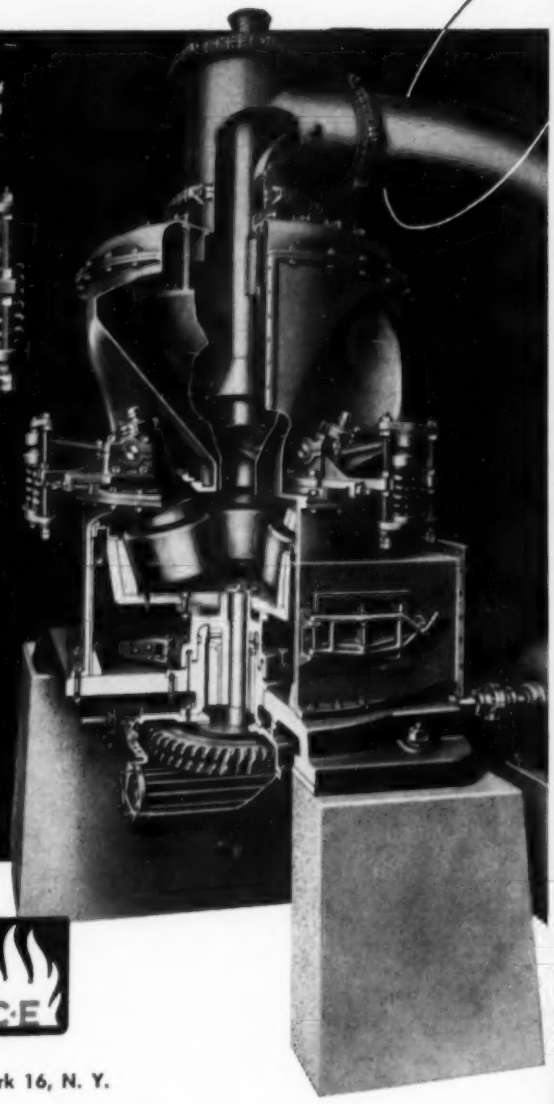


This chart presents a quick picture of the tremendous acceptance of the Bowl Mill since its introduction in 1935.



Cutaway view showing assembly of roller journal in bowl. Note: 1 — no metal-to-metal contact; 2 — self contained lubrication system (no grease cups); 3 — convenient method of adjustment without dismantling.

Looking down on top of mill. See handy arrangement of levers which adjust vanes — while in operation — to control fineness of coal leaving mill.



COMBUSTION ENGINEERING

C-E

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

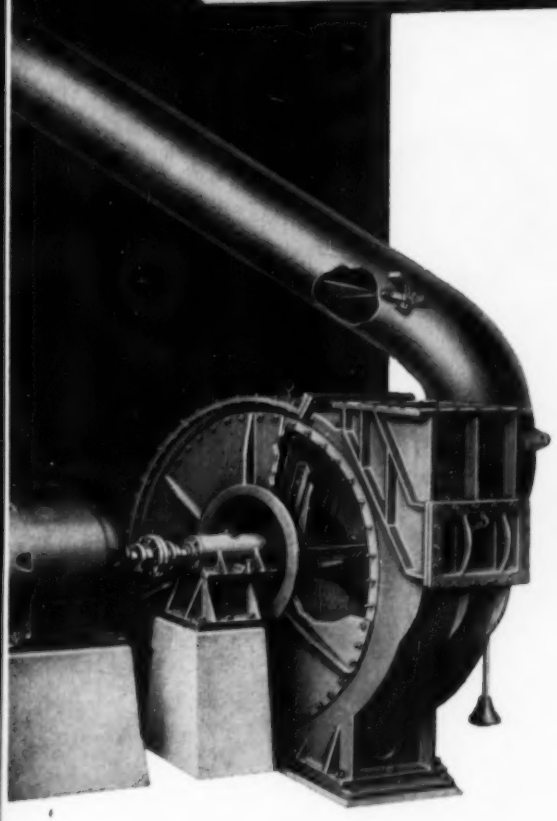
Canada: Combustion Engineering-Superheater Ltd.

8-912

A first-class pulverizer should possess certain basic capabilities of which the following — most operators will agree — are the most important. They are the ability to . . .

- ***handle high moisture fuels without difficulty***
- ***operate with low power requirement***
- ***stay in continuous service for long periods***
- ***operate with low maintenance costs***
- ***permit convenient control of fineness while running***
- ***adjust grinding pressure automatically***
- ***lubricate, when required, while in operation***
- ***operate quietly and without vibration***

It is because the C-E Raymond Bowl Mill measures up on *all* these points that it has long been regarded by many leading power engineers as the country's No. 1 pulverizer. The reasons why the Bowl Mill is an outstanding all-around performer are summarized below.



HIGH MOISTURE — The most effective means of achieving good pulverizing results with high moisture fuels (16 – 18% – Eastern coal, 24% Midwestern, 45 – 50% lignites) are (1) by the admixture of fuel already dried in the mill with the raw feed and (2) by the use of high temperature air. The C-E Raymond Bowl Mill was designed to do both of those things, and does them well. Air temperatures of 700° F. and above can be utilized.

LOW POWER CONSUMPTION — Basic design characteristics of the Bowl Mill permit pulverizing at less power per ton of material than any mill now available. The rapid flow of material through the mill and the prompt removal of fine coal as it is produced prevents over-grinding. This, in conjunction with the relatively low mass of grinding elements and rapid drying action in the mill, assures minimum power consumption.

RELIABILITY — Design and materials are responsible . . . but results prove the point — such results for example as operating records of 8500, 10,000, 15,000, 20,000 continuous service hours without repair or replacement of parts.

MAINTENANCE — Bowl Mill maintenance cost has always been the lowest in the field. Continuing improvements in designs, materials and construction keep it that way. A minimum of outage time is required for dismantling and assembly. It's a matter of record in many plants that higher costs of material and labor over the past 15 years have not been reflected in increased maintenance cost per ton of coal pulverized.

FINENESS CONTROL — All necessary adjustments to control fineness of finished product can be made conveniently from the outside of the pulverizer *while it is in operation.*

AUTOMATIC GRINDING PRESSURE — The arrangement of spring-loaded roller journals on the Bowl Mill provides automatic compensation for the variation in pressure between grinding surfaces required by variation in grindability of coals.

LUBRICATION — Is no problem with the Bowl Mill. When required — at infrequent intervals — all lubrication is handled from outside the mill while it is in service.

VIBRATIONLESS — QUIET — The Bowl Mill's grinding rollers make no metal-to-metal contact with the grinding ring, assuring quiet, vibrationless operation.

• • •

Whether you are evaluating pulverizers for your present plant expansion program or for future requirements, we suggest you use the above check list to get the facts. Send for Catalog PC-8 for further details.

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more data circle 510 on Post Card

ECONOMICAL FROM EVERY ANGLE

'AMERICAN' "Every Angle" THERMOMETERS

No longer is it necessary to fuss and figure what angles of stem connection are required in thermometers for each location. These American "Every Angle" Dial Thermometers can be set at any angle within 180° on *two* axes – set at the best angle for easiest reading.

Regardless of what piping arrangements are engineered into your processes – no matter how many times they are revised – the list of American "Every Angle" Thermometers in your original specifications need not be changed. Equally important, your thermometer inventory in all required temperature ranges and stem lengths will be far smaller. That's real economy – from every angle.

Bi-metal . . . mercury . . . vapor pressure – all three types of actuation are available in American "Every Angle" Dial Thermometers. They are precision instruments that assure accuracy within 1% of scale range. Their high accuracy is sustained throughout service life, whether installed indoors or outdoors.

Make full use of these highly sensitive thermometers at all important check points in your plant. You will maintain product quality far better than ever before. Your field operators will be able to take readings more easily, more accurately, more frequently – will save time-stealing trips to the control house. Convince yourself of the all-around economy of American "Every Angle" Dial Thermometers. Write for complete information.

BI-METAL ACTUATED, TYPE 6060AH. 5" Anti-Parallax Maxivision Dial. **Temperature Ranges:** –80/120 F. to +200/1000° F. **Stem Lengths:** 4" to 24". Climate-proof stainless steel case.

MERCURY ACTUATED, TYPE 6042RM. 4½" Anti-Parallax Maxivision Dial. **Temperature Ranges:** –20/120° F. to 200/1000° F. **Stem Lengths:** 4" to 24". Climate-proof glass and stainless steel case.

VAPOR PRESSURE ACTUATED, TYPE 6040TW. 3½" Dial. **Temperature Ranges:** –20/120° F. to 260/450° F. **Stem Lengths:** 3" to 24". Models for indoor or outdoor service.

Separable sockets can be supplied in all materials and sizes normally required.

SET-ABILITY THAT MEANS FLEXIBILITY IN APPLICATION

SET IT for use as a side angle, 90°, oblique or top connection thermometer.

SET IT for use as a straight-form thermometer.

SET IT for use as an oblique-form thermometer.

SET IT for use as a standard 90° back-connected thermometer.

CALL ON YOUR INDUSTRIAL SUPPLY DISTRIBUTOR for experienced counsel in dial thermometer selection. You can depend on him for prompt delivery from local stocks.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

AMERICAN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn., and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

For more data circle 511 on Post Card

SOLID WHEEL

spells non-stop turbine performance

It's easy to see why Terry solid-wheel turbines have been setting non-stop records. They're built for long periods of continuous service.

The rotor, for example, is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out.

What's more, the blades can't foul. There is a one-inch clearance on either side of the wheel and the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets at right angles to the shaft.

You, too, can profit from Terry solid-wheel stamina. Bulletin S-116 gives full details. Send for a copy today.

THE TERRY STEAM TURBINE CO.
Terry Square, Hartford 1, Conn.

Action of steam in a Terry solid-wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

TT-1205

TERRY

For more data circle 512 on Post Card

Tapered for positive suspension.
High radial sealing surface.
"Tongue and groove" for easy installation.
Clearance for radial motion.

KOPPERS HUHN CARBON RING

Reduces Steam Loss as much as 90%!

The unique design of Koppers Huhn Carbon Ring reduces steam loss far below the customary 1% loss of labyrinths and carbon garter spring rings. Huhn Carbon Ring keeps steam loss as low as ¼ of 1% . . . often as little as 1/10 of 1%. Using your own figures for steam costs, you can easily discover how much Koppers Huhn Carbon Rings can save you annually.

The design assures you continuous radial sealing . . . because a radial sealing surface is always forced against a chamber wall. Automatic suspension . . . even during shutdowns . . . prevents shaft contact, reduces wear, and prolongs life. The Huhn Carbon Ring operates with peak efficiency at highest shaft surface speeds and highest operating temperatures.

Koppers Huhn Carbon Ring replaces labyrinths and carbon garter spring rings in compressors, and steam and water turbines. Steam savings alone often pay within a year for the cost of replacement. Discover now how Huhn Carbon Rings reduce steam and fluid losses and minimize operating, maintenance and repair costs. Write: KOPPERS COMPANY, INC., *Piston Ring and Seal Dept.*, 7407 Hamburg St., Baltimore 3, Md.

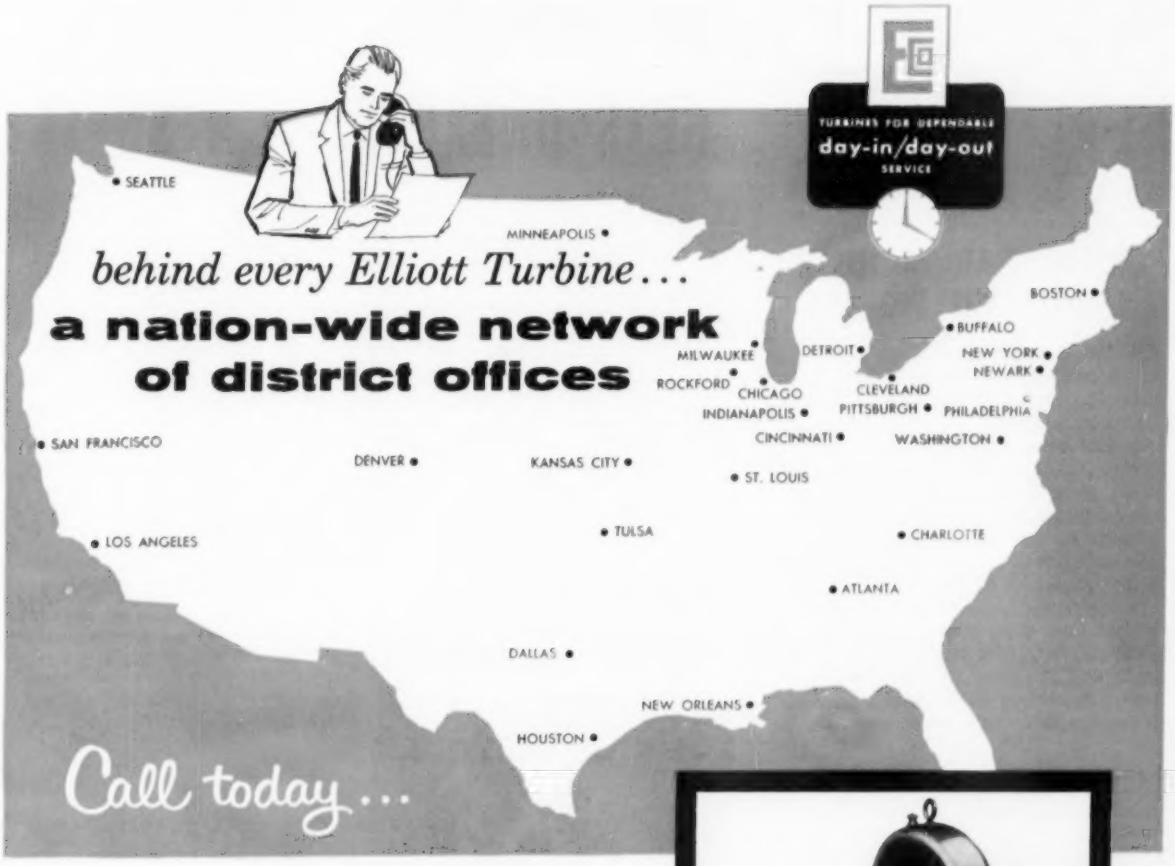
Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.

***Engineered* Products**
Sold with *Service*

KOPPERS ®

MECHANICAL SHAFT SEALS

For more data circle 513 on Post Card



behind every Elliott Turbine...

a nation-wide network of district offices

Call today...

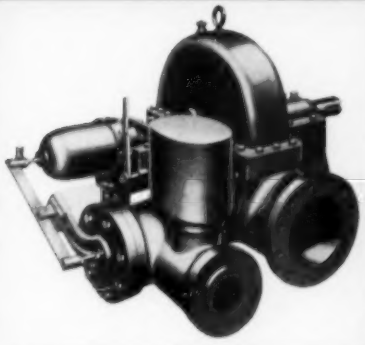
for application engineering

for operating recommendations

for maintenance service

You don't have to wait several days or even weeks for a delayed mail reply or for a turbine service engineer from a distant head office. Near every Elliott turbine installation—and thousands of Elliott turbines are in operation in process industries everywhere—you'll find an Elliott District Office providing *prompt, fast and efficient service.* Time-consuming red tape and complicated approval systems are strictly taboo.

the Elliott man in the Elliott district office is thoroughly trained to furnish designing specifications, application data, and complete costs on Elliott turbines, from the smallest single-stage to large multi-stage types. He is an engineering expert, fully capable of diagnosing your operating difficulties and of planning an effective maintenance program. Call him today.



The Elliott "Planned Maintenance" Program eliminates need for large costly inventories

Since YR turbine wearing parts are completely interchangeable, a stock of spares for each turbine is unnecessary. The Elliott field engineer will help you analyze minimum replacement requirements. Ask him for Bulletin H-23, or if you prefer, write Elliott Company, Steam Turbine Department, Jeannette, Pa.

H7-4

ELLIOTT Company

Steam Turbines • Motors • Generators • Deaerating Heaters • Ejectors • Condensers • Centrifugal Compressors • Turbochargers • Tube Cleaners • Strainers

For more data circle 514 on Post Card

ONE-SHOT "BOILER TREATMENT" GETS UNEXPECTED RESULTS

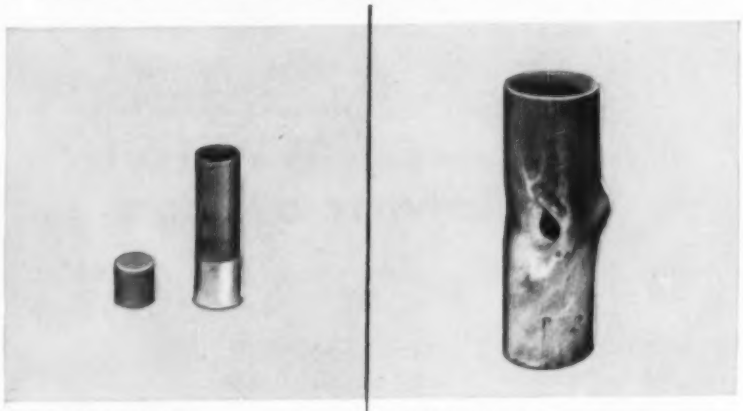
CEMENT MANUFACTURER SHOOTS THE WORKS!

CLEANING rotary cement-drying kilns by firing lead slugs into them to knock off accumulations inside is routine practice. The slugs go bounding and bouncing through the long drying kiln, doing a cleaning job equivalent to a whole crew of pick-and-shovel pilots. No one expects a slug to become so enthusiastic that it continues its chores inside the waste heat boiler attached to the far end of the kiln. In fact, the odds against getting a slug into the boiler *on purpose* are astronomical. But this one got there, odds and all, thus establishing a new type of one-shot boiler treatment which is hardly likely to become popular.

HOWEVER, *inside* the boilers at this large cement plant, Nalco System treatment helps make certain that boiler troubles, if any, are on the outside. Boiler feedwater is aerated, filtered, zeolite softened, evaporated and deaerated. A Nalco corrosion inhibitor is fed between deaerators and feed pumps for corrosion control throughout the steam and condensate return systems. Nalco catalyzed sodium sulfite does the oxygen scavenging on the discharge side of feed pumps. A Nalco internal treatment and caustic soda are fed directly into the boiler for pH control and scale prevention.

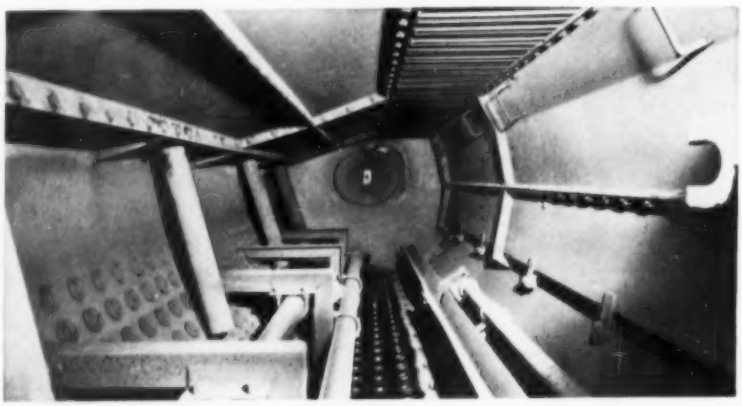
It is no wonder these boilers can turn out 169,000 lbs. of steam per hour, year after year, and stay like new—except, of course, for the wayward shotgun slug.

Nalco has not yet developed bullet proofing for boilers . . . But you can never tell what may come next! Meanwhile, we'll be happy to tell you more about effective Nalco Internal Treatment. Ask for Bulletin B1. National Aluminate Corporation, 6224 West 66th Place, Chicago 38, Illinois. In the Northwestern United States, Hawaii and Alaska: The Flox Company, Inc., Minneapolis, Minnesota. In Canada: Alchem Limited, Burlington, Ontario. Branches and affiliates in Spain, Germany and Italy.



THE TREATMENT: Lead slug, propelled by heavy powder charge in 8-gauge shell fired from a miniature cannon! "External treatment" with a vengeance.

THE RESULTS: "Plugged" boiler tube, pierced by lead slug on the pay off to one chance in a million. Internal treatment powerless here.



Steam drum in one of the Nalco-treated boilers at cement plant is typically clean and corrosion-free when opened for annual inspection.

Water treatment chemical mixing and proportioning room, where Nalco System treatment starts on its way to give complete steam system protection against scale and corrosion.

For more data circle 515 on Post Card

HELPFUL BULLETINS

PUMPS, PUMPING

101 Industrial Pumps — This 8-pp bulletin, Form 409, features application data on pumps for petroleum products, including LP-gas, many types of chemicals, dry cleaning fluids, paints, resins, diesel fuel, food products, as well as all types of asphalts, tars, road oils, etc. Typical installations are illustrated and performance details described. Viking Pump Co.

102 Vertical Service Pumps — Six-pp Bulletin SCP describes company's short coupled vertical service pumps. It explains the many uses of service pumps, including suggested installation plans, existing installations for oil refineries, pipe lines, municipal and private water works systems. Layne & Bowler, Inc.

103 Industrial Pumps — A number of different types of industrial pumps for a variety of applications are illustrated and described in this pamphlet. Size and capacity data are listed for each type in the line. C. H. Wheeler Mfg. Co

104 Submersible Pumps — Eight-pp Bulletin B-1000 describes 6- and 8-in. deep well submersible water supply pumps, used for plants, institutional and commercial buildings, and all types of services such as water supply, air conditioning, processing, and fire protection. A large cutaway view shows component features, and a performance chart tabulates engineering data. Sumo Pumps Inc.

HEATING

105 Gas Heating Equipment — Catalog GN-57, 18 pp covers company's gas-fired commercial and industrial heating equipment, including suspended gas unit heaters, a floor model heater, two series of duct furnaces, and a horizontal furnace. In addition to specifications, construction details and dimension drawings and tables, it also contains installation and application information. Reznor Mfg. Co.

106 Cabinet Convectors — This 28-pp data guide on Code rated cabinet convectors for steam and hot water heating systems lists details of design and construction for installation in commercial, ndustrial, other buildings. Photos and schematic drawings illustrate the text, and technical data, hot water capacity statistical tables for all models, miscellaneous capacity data, and typical piping arrangements for both hot water and steam systems are included. Dunham-Bush, Inc.

FANS, VENTILATING

107 Industrial Fans — A broad line of industrial fans, including low silhouette 'dome' type roof and wall ventilators, centrifugal roof ventilators and utility blowers, air blasters and man coolers, in addition to panel and tubeaxial general and pressure duty exhaust fans, are featured in 20-pp Form PL-801. Illustrations, features, dimensional and performance data are included. Power Line Fan Co.

108 Utility Sets — Bulletin 8414, 28 pp, describes company's H S utility sets, detailing features and advantages, and selection factors such as space volume, quantity of fresh air required, altitude and temperature correction, outlet velocity, duct size, static pressure and tip speed. Tables of minimum outdoor air requirements, recommended duct velocities, outlet velocity and tip speed values for backward inclined blade fans and correction ratios for temperature and altitude included, also capacity and dimensional data. American Blower Div., American-Standard.

109 Air Diffusion Equipment — Catalog 1-57, 66 pp, describes and illustrates company's complete line of grilles and registers. Profusely illustrated with photos and dimensional diagrams, the bulletin contains complete engineering data, including size selector chart and other selection information for each of the 26 standard sizes. Waterloo Register Co., Inc.

110 Automatic Air Filtering — Bulletin 780 describes air handling units that incorporate automatic air filtration. Explains adaptability of the filtering by the roll principle to heating and ventilating units, industrial heaters, auditorium unit ventilators, and air conditioning units. Dimension drawings and specification charts are included in the bulletin. American Air Filter Co., Inc.

VALVES, PIPING, FITTINGS

112 Control Valves — Condensed Catalog 57 describes pressure and temperature regulators; solenoid, diaphragm, motorized and float valves; pressure reducing, flow control, safety and relief valves; strainers. Photos of individual models and specifications are included. O. C. Keckley Co.

113 Diaphragm Valves — Twelve-pp Catalog 104 describes features of manufacturer's diaphragm valves for positive closure and the latest in plastic valves and diaphragms for corrosive services. A quick reference chart for diaphragm material selection is included. Dimensional specifications for several valve models are also shown. Hills-McCanna Co.

114 Semi-Steel Valves — Bulletin V-203 Rev. 1, 44-pp, covers company's entire semi-steel valve line. The completely revised edition includes a number of new features, including two pages of photos, drawings and detailed description of lubricants and lubricating methods, and cutaway photos showing working parts of 4 types of semi-steel valves — two-bolt cover, screwed-gland, bolted-gland, and multiport types. Specifications included. Meter and Valve Div., Rockwell Mfg. Co.

115 Valves for Steel Mills — Sixteen-pp Bulletin SM-1, titled, "Valves for Automation in the Steel Mills," shows various piping and valve arrangements for particular applications. These include supply water from source to mill; emergency city connection; spray valves for hot strip mills; coke quenching and drain valves. Golden-Anderson Valve Specialty Co.

116 Friction Loss Calculator — This handy pocket slide calculator is designed for figuring water pipe and paper stock pipe friction losses. Data for computing water pipe friction loss are based on standards of the Hydraulic Institute and appear on one side of calculator while those for determining paper stock pipe friction loss are on the other. It also carries a table of equivalent lengths of new straight pipe for valves and fittings for turbulent flow. Allis-Chalmers Mfg. Co.

117 Pipe, Tubing, Fittings — Power engineers concerned with equipment involving use of tubing and piping at high temperatures will be interested in Bulletins 145A and 152A. The former discusses company's Croloy $2\frac{1}{4}$ and the latter, Croloy $1\frac{1}{4}$. Both present technical data on analysis, mechanical and physical properties, fabrication, heat treatment and maximum allowable working pressures for various applications at different metal temperatures. Tubular Products Div., The Babcock & Wilcox Co.

118 Flexible Hose, Bellows — Sixteen-pp Catalog 156 describes applications and use of flexible metal hose and bellows. Engineering specifications and sizes, pressure ratings, materials and fitting attachments are included. Detailed drawings and pictures facilitate specification of individual applications. Charts of the various metal-formed bellows and hose are provided. Flexonics Corp.

119 Corrosion-Resistant Coupling — Bulletin 270 describes the HK coupling, a quick-connect coupling using Teflon seals designed for handling acids, alkalis, solvents and high pressure steam. A cutaway view illustrates component parts of the coupling. Snap-Tite, Inc.

STEAM GENERATORS

120 Steam Generators — Bulletin B-56-5, 68 pp, covers steam generating equipment for large central station and industrial installations of all types, including reheat and dual circulation. Profusely illustrated with cross-section line drawings of typical installations, the bulletin includes data on coal-, oil- and gas-fired units; descriptions of pulverized-fuel systems, burners, drum internals, reheaters, superheaters, accessories. Foster Wheeler Corp.

Do any of these catalogs answer your operating or maintenance needs? Let us know by circling the number of the catalog on the post card provided on pages 97–98. We'll do the rest!

121 Boiler-Burner Units — Advantages of company's water tube boiler-burner units are described in Bulletin 900. Standard boiler and equipment is covered and burner requirements are briefly discussed. International Boiler Works Co.

MECHANICAL POWER TRANSMISSION

123 Speed Reducers — Use of double-enveloping worm gearing in Cone-Drive speed reducers is described in 24-pp

Bulletin CD-218. Standard stock capacities are listed, and specifications for all extended shaft and shaft mounted models are given, as well as dimensioned drawings and tables of mechanical and thermal hp ratings, output torque ratings and chain pull ratings. Cone-Drive Gears Div., Michigan Tool Co.

124 Drives for Feed Pumps — High-speed multi-stage steam turbines to drive boiler feed pumps in generating stations of 150,000 kw capacity and up are described in 16-pp Bulletin GEA-6541. Graphs show economical advantage of steam turbines for boiler feed pump drives, and amount of additional saleable kilowatts possible through their use. Cycle arrangements for both condensing and non-condensing turbines are included. Design features described include suspended nozzle assembly, internal oil piping, local and remote instrumentation. General Electric Co.

125 FHP V-Drives — Form F-10 is a 46-pp source of information on fractional horsepower V-drives and drive parts and accessories. In the range of fractional to 10 hp, it presents descriptions and complete size data on company's line of bushed type and fixed-bore type cast iron and pressed steel V-pulleys, V-belts, refrigeration fans and fan pulleys, and V-drive accessories. An engineering data section is included. Maurey Mfg. Corp.

126 Machined Parts — A complete line of gears, transmissions and other machined parts are described in this 26-pp catalog. How complete engineering and designing facilities, seven plants and over 2700 machine tools enable company to solve production problems for the automotive, aviation, appliance and many other industries is fully illustrated and described. New Process Gear Corp.

MATERIALS HANDLING

127 Diesel Tractor — Bulletin MS-1192 is a fold-out specification sheet covering company's HD-16 diesel-powered crawler tractor. Features a cutaway view of the tractor showing both gear-type and hydraulic torque converter drive transmissions, as well as mechanical, design and construction details. Construction Machinery Div., Allis-Chalmers Mfg. Co.

128 Car Pullers — Bulletin J-11, 32 pp, contains a description of several installations and various types of car pullers for moving freight cars, barges, scrap buggies, furnace cars and many types of industrial transfer cars. Features case histories of typical users, design and selection data, ratings and dimensions and installation data, and is illustrated with photos, dimensional diagrams. Hewitt-Robins, Inc.

129 Wire Rope Recommendations — Bulletin DH-129-B, 16 pp, describes company's complete line of preformed wire rope, wire rope accessories, and cable assemblies. Contains data on construction features, applications, diameters, and pictures many applications of wire rope and cable. Hazard Wire Rope Div., American Chain & Cable Co., Inc.

INSTRUMENTS AND CONTROLS

130 Basic Controls — More than 34 basic types of industrial temperature and pressure controls are included in this 96-pp industrial catalog. Covers self-operating regulators, water mixing equipment, pneumatic control instruments, indicating and recording instruments, control valves and pneumatic motors. Equipment described is designed for industrial process control, as well as for heating, ventilating, and air conditioning systems, and hot water service applications. Powers Regulator Co.

131 Automatic Controls — Automatic package controls, for virtually any industrial application where a chemical or mechanical function can be measured electrically, are described in 16-pp Catalog AC-2. These include control of temperature, torque, viscosity, current, voltage, timing of welding, conveyor overload, speed, battery charging, radiation, moisture content, pressure, deflection, thickness, weight, others. Tipptronic, Inc.

132 Temperature Controls — Bulletin F 2287-4 discusses the applications of company's Electronic temperature controls for the heating, ventilating and air conditioning field. Explains features, functions and advantages, and illustrates components and accessories used in various types of Electronic systems, as well as specific applications of each. Barber-Colman Co.

133 Meter Selection — Bulletin 566, 28 pp, has been completely revised to aid in selecting the best meter-register combination for any industrial liquid metering job that can be handled with company's standard line of meters. Arranged in comparative chart form, subjects covered include: how meters save; list of liquids that can be handled; construction details; register types; and sizes of meters. Accessories, installation directions and application photos are included. Neptune Meter Co.

134 Pneumatic Control — Complete information on the Speedomax G pneumatic control for steel, chemical, petroleum and allied industries is presented in 12-pp Folder ND4(9). Included are line drawings illustrating pertinent details and a block diagram showing how pneumatic system works. Leeds & Northrup Co.

135 Contact Meter-Relays — Contact meter-relays, versatile instruments that both indicate and control almost any physical or chemical condition that can be detected electrically, are described in 40-pp Catalog 4-C. Supplies complete information for ordering and discusses various circuits for providing different types of control action. The catalog contains complete specifications for the various models and is illustrated with photos and circuit diagrams. Assembly Products, Inc.

136 Gas Regulators — Catalog 806, 40 pp, covers pressure regulators for industrial compressed gases. It deals with various types of cylinder, manifold, and pipeline regulators, both single- and two-stage, and specialized equipment, such as laboratory and metering regulators and gas proportioners. Flow and pressure charts in graph form give data on performance. In addition, related equipment — such as valves, adapters, hose connections, and pressure gages — is illustrated. Air Reduction Sales Co., Div. of Air Reduction Co., Inc.

137 Pressure Regulators — Revised size, capacity and weight tables necessitated by doubling of maximum inlet pressure of manufacturer's No. 120 sensitive gas regulators are in Bulletin 1044, Rev. 6. Capacity tables make allowance for fact that regulators' capacity is no longer limited to amount of gas or air passed at a 1 psi inlet-outlet differential. Meter & Valve Div., Rockwell Mfg. Co.

138 Control Manifolds — Eight-pp Catalog 956 describes the original ¾ and 1 in. manifold, and the new ½ in. size recently added to the line. Components are fully detailed, as well as applications and other data, and installation dimensions are diagrammed. Republic Mfg. Co.

ELECTRICAL

140 Weather-Protected Motor — Features which contribute to outdoor dependability of these weather-protected motors are described in 6-pp Bulletin 51B8606A. Construction features are illustrated and a diagram showing flow of ventilation air is included, as well as motor ratings chart. Allis-Chalmers Mfg. Co.

141 Totally-Enclosed Motors — Bulletin 500-A describes company's totally-enclosed, fan-cooled motors in ratings from ½ to 40 hp. Ratings and dimensions are listed on tables. Robbins & Myers, Inc.

142 Electric Motor Care — Based on two recently released colored slide films, Bulletins 51X8581 and 51X8582 are entitled "How to Make a Motor Go . . . and Go, and Go, and Go," and "How to Take Step Seven." Both of these bulletins graphically tell the story of correct electric motor inspection and maintenance. Allis-Chalmers Mfg. Co.

143 Part Winding Starters — Bulletin GEA-6606 discusses advantages of two-thirds part-winding starting and gives application data, connection diagrams, part-winding characteristics of a typical motor, nomenclature and price information on the CR7050 part-winding starter designed for either one-half or two-thirds part winding of standard motors or special part-winding motors for reduced kva inrush. General Electric Co.

144 On Magne-Blast Breakers — Bulletin GED 3337, 6 pp, describes operation and application of new stored energy closing mechanism for magne-blast circuit breakers rated 150 mva or higher. Includes exploded schematic drawing of stored energy feature, photos of equipment, and diagram of typical system employing metal-clad switchgear with stored energy. General Electric Co.

145 Voltage Regulators — Bulletin RV2, 16 pp, provides complete information on company's complete line of pole type voltage regulators. Application, operation, features, ratings, physical data, and accessories are covered, illustrated with photos, cutaway views and diagrams. Line Material Industries.

146 Dustproof Capacitor Units — Bulletin PC8, 16 pp, describes indoor low-voltage dustproof capacitors and equipments, including information on individual capacitors, multiple capacitor equipments, and indoor low-voltage capacitors for industrial applications. Outline drawings are included, as well as weights, dimensions, other data. Line Material Industries.

147 Current-Limiting Fuses — Bulletin GEA-6319B, 8 pp, describes CLF current-limiting fuses capable of interrupting short circuit currents up to 200,000 RMS symmetrical amperes. Publication describes operation and typical application of the fuses, includes dimensions and ratings, and graphically illustrates current characteristics. General Electric Co.

148 Plug-In Busway — This illustrated bulletin describes advantages of the

Burn COAL the MODERN WAY

with DETROIT STOKERS and SAVE!

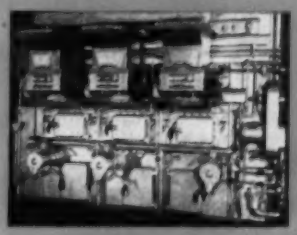
Coal is the economical fuel in most industrial areas. Safest to handle and store, its steady and continued supply is assured by huge reserves.

With a Detroit Stoker you can burn coal the modern way . . . saving 10% to 40% over other fuels.

Detroit Stokers are dependable, durable . . . last for decades. There is a type of Detroit Stoker to meet your needs.

Let us show you the savings available. Recommendations by our engineers will cost you nothing.

DETROIT ROTOSTOKER



Spreader stoker. Economically burns all grades of Bituminous coal or Lignite. Power, hand dumping or stationary grate types.

DETROIT LOSTOKER

Compact underfeed stoker for smaller boilers. Capacities 3,000 to 12,000 pounds steam per hour. Plunger feed, mechanically driven side cleaning. Coal feed and air supply may be automatically controlled.

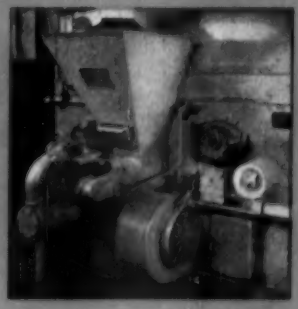
DETROIT ROTOSTOKER—TYPE C-C

(Continuous Cleaning) Reciprocating grates that slowly discharge ash at front. Steaming capacities from approximately 5,000 to 75,000 pounds. Smokeless with wide load range.

DETROIT SINGLE RETORT STOKER

(Detroit UniStoker)

Side cleaning, underfeed stokers. Motor or turbine driven. Adjustable feed provides manual and automatic control. Capacity range 12,000 to 24,000 pounds steam per hour.



DETROIT ROTOGRATE STOKER

Spreader stoker, for higher capacities up to 400,000 pounds. Forward moving grates that discharge ash at the front. Higher burning rates for longer periods. Heavy duty.

DETROIT DOUBLE RETORT STOKER

Side cleaning heavy duty underfeed stoker with two retorts, mechanically driven. Available for capacities from approximately 20,000 to 34,000 pounds steam per hour. Requires no basement.

DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

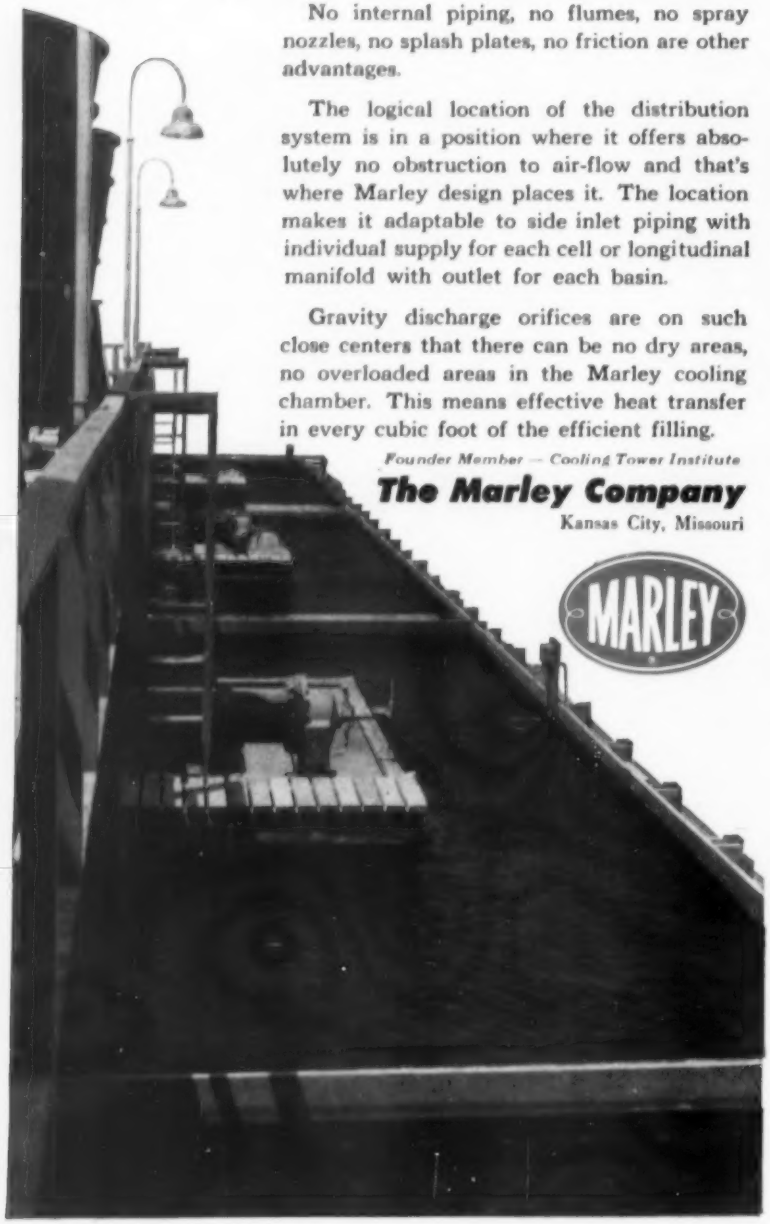
DETROIT SINCE 1898 STOKERS

For more data circle 516 on Post Card

Marley
Open Gravity Distribution
so simple, so logical, so effective

Water seeks a lower level. Hot water distribution on Marley Cross-Flow cooling towers is just that simple, and the advantages of this fundamentally sound system are many.

It is the only method that gives the operator control of the tower. At a glance, he can observe flow in each basin, and the balance between basins. He can change the flow in any cell at will and have positive knowledge of the result — immediately.



No internal piping, no flumes, no spray nozzles, no splash plates, no friction are other advantages.

The logical location of the distribution system is in a position where it offers absolutely no obstruction to air-flow and that's where Marley design places it. The location makes it adaptable to side inlet piping with individual supply for each cell or longitudinal manifold with outlet for each basin.

Gravity discharge orifices are on such close centers that there can be no dry areas, no overloaded areas in the Marley cooling chamber. This means effective heat transfer in every cubic foot of the efficient filling.

Founder Member — Cooling Tower Institute

The Marley Company

Kansas City, Missouri

MARLEY

For more data circle 517 on Post Card

plug-in Uni-Bus feeder designed for flexibility, economy and safety in power distribution. A typical specification is detailed. Electric Distribution Products, Inc.

149 Electrical Insulation — Class H and C materials for high temperature electrical insulation applications are presented in this 12-pp booklet. Both rigid and flexible insulations are covered and the custom fabrication of Isomica, Micanite and Lamicoid discussed. All materials are described and information provided as to fields of application. Data on essential electrical, physical and mechanical characteristics are provided in tabular form. Mica Insulator Co.

150 Insulation Products — Standard packaged electrical insulation products are described in 12-pp Catalog 21. Types covered include wood wedges, formed fiber wedges, rag paper, nylar-paper combinations, creased separator coils, crimped transformer insulators, others. Illustrated with photos and drawings, bulletin includes complete size and price data. Insulation Manufacturers Corp.

. . . *Outstanding Among This Month's Catalogs*

152 Cooling Towers — Bulletin CT-57-1, 32 pp, describes induced-draft counterflow cooling towers. Lists advantages and describes construction and operation of all major parts, effects of recirculation and surroundings. Profusely illustrated with photos, drawings and charts, the bulletin also includes data sheet to help in preparing inquiry. Foster Wheeler Corp.

153 Data on Relays — Technical information on magnetically held and mechanically held relays is presented in 42-pp Catalog 57-84. Covers applications, ratings, specifications, design and mounting information, and includes wiring diagrams and outline dimensions, as well as application photos and other illustrative detail. Automatic Switch Co.

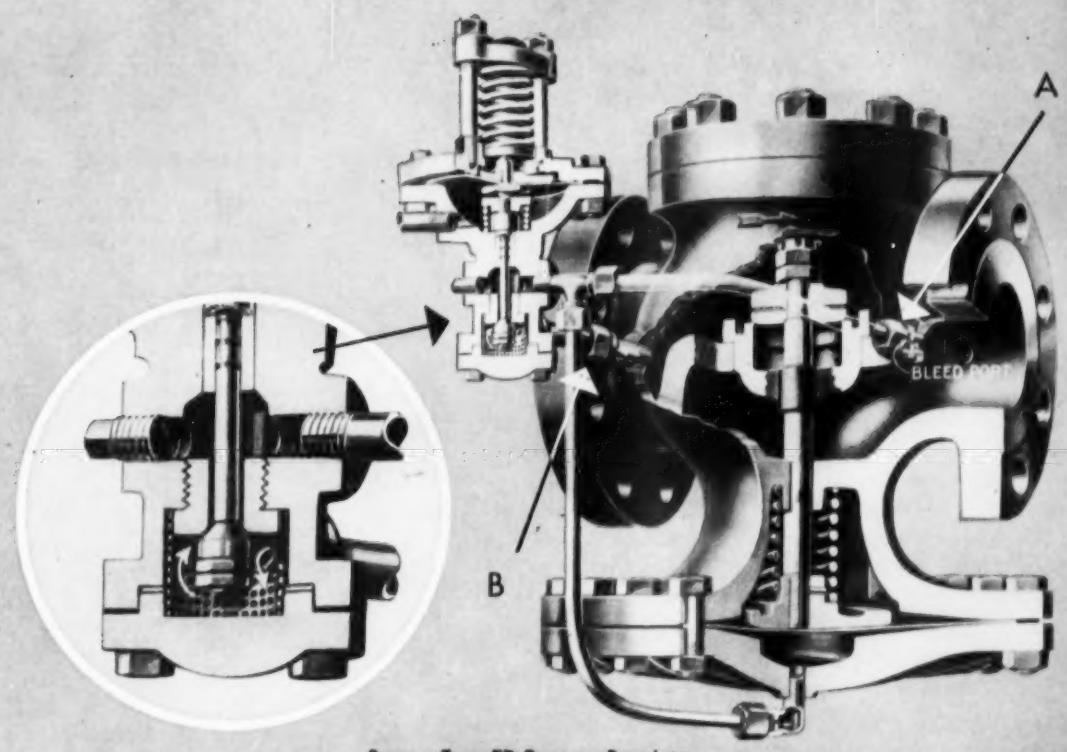
154 Gaskets, Packings — This 48-pp catalog contains a wealth of information on industrial gaskets, mechanical packings, boiler gaskets, packing hooks, steel rule dies. Also outlined are manufacturer's facilities for contract die cutting and fabricating of non-metallic materials. An engineering section includes a gasket recommendation chart, mechanical formulas and decimal equivalent table. Rhopac, Inc.

LIGHTING

155 Electrical Specialties — Switches, industrial sockets and portable lamp guards are described in the 32-pp "Handy Book of Electrical Specialties." Includes detailed descriptions and illustrations of all equipment, as well as specifications. McGill Mfg. Co., Inc.

156 Mercury-Lamp Transformers — Bulletin GEC-1440 gives application, price and dimension data, wiring diagrams, superseded as well as new catalog and model numbers, on company's mercury-lamp transformers and reactors for 120- through 480-v operation, 60 cycles, high and low power factor, in a variety of construction types. General Electric Co.

Advantages of External Pilots in Automatic Regulating Valves



Spence Type ED Pressure Regulator

"Maintenance-free, trouble-free, install-and-forget." They're all pretty phrases, but every engineer knows from experience they don't apply to regulating valves. Any valve designed to control temperatures or pressures within tight limits can be affected by dirt or other foreign matter in steam lines.

One advantage of the external pilot mounting shown above is simplified maintenance. Trouble shooting is faster, downtime is reduced, and tempers don't take such a beating. Here's why:

If trouble develops, it's easy to find out if it's in the pilot or the main valve. Just remove the tubing bend at A. A simple test, without any instruments or other equipment, shows where the trouble is.

If the trouble is in the pilot, you can remove it by disconnecting the unions at B. There's no need to take the main valve out of the line.

The quickest way to get the regulator functioning again is to install a spare pilot. This is easy — and in the Spence design it's not expensive to carry spare pilots. Spence pilots fit all sizes of Spence main valves. There's no need to stock an expensive inventory of pilots for each main valve size.

In the enlarged sectional drawing above, you can see how the strainer, seat and disc of the pilot are readily accessible by removing the blind flange.

If the trouble is in the main valve, here again inspection is easy. If there's dirt in the steam line, it may clog the bleed port or restriction orifices. In the Spence design these can be inspected and cleaned by merely removing the tubing connections. The seat and disc of the main valve can also be inspected easily by removing the top flange.

These maintenance advantages, plus other advanced design features, are available for a wide range of regulating applications. For information on Spence's wide range of different automatic regulating valves, write for your copy of Bulletin 1005.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

For more data circle 518 on Post Card

Are your Tube Cleaners ready for action

If you haven't checked your tube cleaner equipment lately, now is the time to make sure it is ready for service when you need it.

Order needed repairs, heads, cutters, brushes, universal joints or hose now, while our stock enables us to make off-shelf delivery. Why wait? Do it now and avoid possible costly delays. Write, wire or

Phone HUmboldt 3-0570

ROTOJET®

TUBE CLEANERS

ELLIOTT COMPANY - ROTO DIVISION

Tube Cleaner Specialists Since 1910

147 Sussex Avenue, Newark, N. J.

For more data circle 519 on Post Card

157 Tips on Ballast Heating — Bulletin GED-3328, 8 pp, points out basic heat problems and objectively describes what causes overheating in fluorescent lamp ballasts. Tells what happens to an overheated ballast and gives steps to avoid ballast overheating and associated problems. General Electric Co.

FIRE PREVENTION

158 ABC of Fire Protection — The nature and advantages of fire protection systems are discussed in 36-pp Bulletin 66. Explains insurance savings and other economic benefits afforded by fire protection. Systems and components are described and pictured. Applications and functions of different types of systems are chartered. Bulletin covers fixed-temperature, rate-of-temperature-rise, alarm and control systems. Methods utilized include water sprinklers, water fog, air foam, chemical foam, dry chemicals and CO_2. Automatic Sprinkler Corp. of America.

159 Automatic Fire Detection — This 12-pp brochure describes a rate-of-temperature-rise fire detector, outlining its operation on a pneumatic principle. It is designed to trigger an alarm at the first unusual rise of temperature in a protected space. According to booklet, these systems are equipped with a reserve 80-hr battery source of electricity. Many users of these systems listed. Walter Kidde & Co., Inc.

REFRACTORIES, INSULATION

160 Cement Mortar Manual — "Lumnite Cement Mortar Manual — Gun-Applied Linings-Masonry" is a 2⅝-pp catalog containing information on mortar preparation, placing procedure, and general instructions for gun-applied linings in oil refineries, power plants, metal and similar industries. An appendix contains information on selected aggregates, thermal conductivities of Lumnite concrete, and strength curves. A bibliography on refractory concrete is included. Universal Atlas Cement Co.

161 High Temp Mortars — Bulletin 600, 6 pp, offers detailed information on high temperature refractory mortars. Illustrates tests and applications as well as products, providing general and technical data on 11 regular and special grade mortars. J. H. France Refractories Co.

Bulletins reviewed here are offered primarily for qualified power engineers. Manufacturers may withhold literature from persons who do not state their job title and company. Some manufacturers also prefer not to send literature to those in foreign countries in which they have no sales representatives.

162 High Temp Insulation — This 6-pp bulletin covers Thermasil calcium silicate insulations for temperatures to 1200 F. Gives basic sizes of insulation for pipe covering and block for process vessels or other equipment. Includes data on basic features. Physical properties are tabulated and thermal conductivity given in graph form. Tables give simplified thickness standards for pipe coverings

Kill Algae

Get SAFE, QUICK CONTROL at Low Cost

Allis-Chalmers No. 120 Series Algaecide eliminates fouling of cooling tower systems by algae and slimes

Check the many exclusive advantages of Allis-Chalmers No. 120 Series algaecide:

- Easy to introduce into the system by means of pump, drip feed or manual feed. No expensive feeding equipment required.
- Safe to handle. Even in concentrated form, it is no more than a mild irritant to skin, eyes and mucous membranes.
- Low toxicity to fish or animals.
- Non-oxidizing.
- Inhibits corrosion.
- Dosage is independent of organic, ammonia, or nitrogen content of makeup water.
- No loss on passage through tower.
- Proved effective in field use.
- Only 2 to 5 ppm required for effective dosage of most organisms.

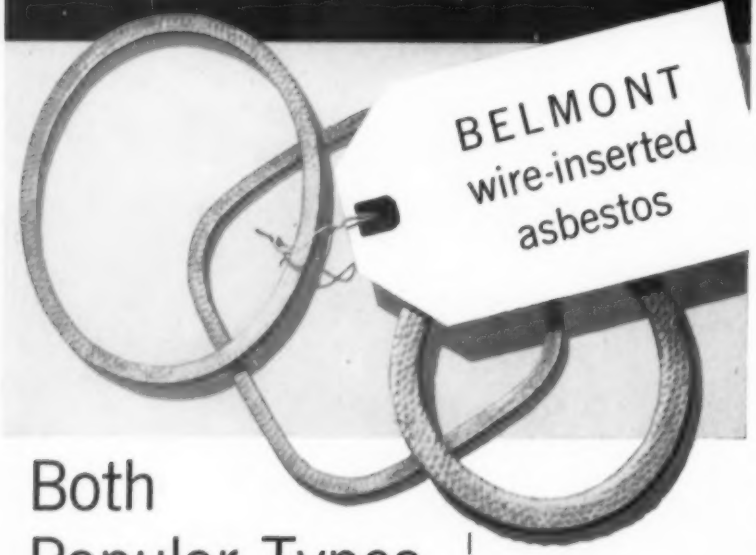
This is the most effective algaecide known. If you have a problem with plugged pump strainers, coated heat exchanger tubes, coated slats in cooling towers, call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 28X8434.

ALLIS-CHALMERS

A-5442

For more data circle 520 on Post Card

BOILER GASKETS



Both Popular Types

Wire-inserted woven asbestos and spiral wound metal-asbestos—for manholes, handholes and tube caps of all makes of stationary and marine boilers, water walls, economizers and other boiler accessories.

ask your BELMONT Distributor

Such leading Packing Distributors as:

M. F. Murdock Co., in Akron

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Standard Supply & Hardware Co., in New Orleans

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Write for Catalog

The Belmont Packing & Rubber Co., Butler & Sepviva Sts., Phila. 37, Pa.

BELMONT

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that permit nesting of layers, reducing plant inventory. Ehret Magnesia Mfg. Co.

OTHER EQUIPMENT

163 Packaged Chillers — Catalog 533, 16 pp, describes a series of nine Flow-Therm packaged liquid chillers rated from 20- through 125-ton capacity. Lists advantages, points out application of units as heat pumps with factory-installed change-over valves, and includes engineering data, capacities, pressure drop data, condenser water requirements and selection table. Acme Industries, Inc.

165 Condensing Units — Semi-hermetic condensing units and motor compressors from ¼ to 3 hp are described in Bulletin G-124R. Features are detailed and specifications and capacities tabulated. The Brunner Mfg. Co.

166 Zinc Coating — This bulletin describes a special zinc coating applied as a paint to provide galvanic protection to metals. A variety of applications are fully detailed. Subox, Inc.

167 For Boiler Cleaning — Bulletin 137A describes company's vacuum cleaning equipment for removing soot from boiler tubes. In addition to describing vacuum producers, soot separators, vacuum tools, and a portable vacuum cleaner, the bulletin includes a diagram illustrating modification of a central cleaning system for removing soot, scale and dirt from boiler tubes, stack bases and breech. The Spencer Turbine Co.

168 Standardized Substation Construction — The use of standardized, modular trusses and small parts for the fabrication of electrical transmission substations is pictured and described in this 8-pp bulletin. It tells how the Erecticon system can reduce engineering and erection costs and pictures typical installations. The Charles E. Schuler Engineering Co.

169 Corrosion-Resistant Material — Zirconium's corrosion resistant properties receive authoritative treatment in the corrosion issue of "More Zr Facts" — an 8-pp brochure published by the company. Brochure includes discussion of uses of zirconium's corrosion resistant properties in various types of atomic reactors and in chemical processing. The Carborundum Metals Co., Div., The Carborundum Co.

170 Galvanic Protection — Two new reference manuals discuss zinc as a galvanic anode to protect iron and steel from corrosion. Sixteen-pp "Zinc as a Galvanic Anode Underwater" tells how zinc anodes protect water storage tanks, H piping in sea water, traveling water screens, and lock gates. Step-by-step procedures are given for effective salt water applications. "Zinc as a Galvanic Anode Underground," 40 pp, discusses theory and practice of zinc anode application in transmission pipe lines, gas distribution systems, ground rods, grounding cells, others. Recommendations indicate best methods of applying zinc for protecting underground systems and structures made of steel. American Zinc Institute, Inc.

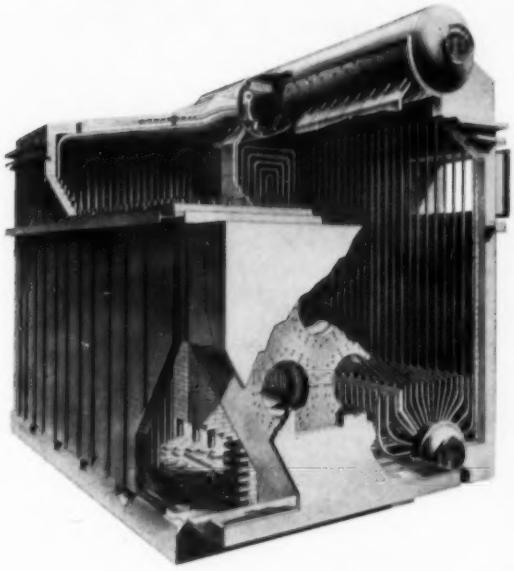
171 Masonry Water Repellents — The various benefits provided by silicone masonry repellents and specifications for applying them are described in Bulletin CDS-81. Photos show results of laboratory tests of effectiveness of silicones in minimizing water absorption, efflorescence, spalling and cracking. General Electric Co.

Here's why you get

IMPORTANT SAVINGS in

- ✔ *first cost*
- ✔ *installation*
- ✔ *operation*
- ✔ *maintenance*

with the FW Series "SC" STANDARD BOILER

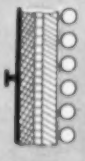


THESE nine Foster Wheeler design features add up to substantial savings in the cost of steam generation. Equally important is the extra *dependability* that's built into every "SC" unit – the result of over 60 years of experience in the design and construction of large, high-pressure steam generators for leading central station power plants.

Pre-engineered in all details and standardized for economy, these FW standard steam generators are available for oil or gas firing, in capacities from 50,000 to 150,000 lb/hr, for pressures to 1500 psi and superheated steam temperatures to 950 F. For complete information, send for Bulletin B-55-4. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

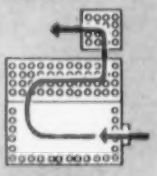
1. COMPLETELY WATER-COOLED WALLS

All furnace walls are cooled by closely-spaced tubes, minimizing setting maintenance and preventing excessive exit gas temperatures.



2. EFFICIENT FIRING ARRANGEMENT

Burner arrangement assures maximum rating without overheating furnace tubes. Rear wall is over 19 ft. from burner wall, permitting long, horizontal flame travel.



3. FULLY DRAINABLE SUPERHEATER

A completely drainable superheater permits removal of all condensed water from the elements before start-up.

4. HIGH STEAM PURITY

The normal drum internals consist of chevron dryers and a dry box. Separators may be added which make possible a steam purity of 1PPM or less.

5. UNRESTRICTED CIRCULATION

Absence of headers provides free circulation through integral risers and downcomers, eliminating header handhole plates and gaskets.

6. BOTTOM SUPPORTED UNIT

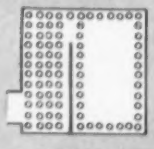
The bottom-supported design fully utilizes the structural strength of the tubes and provides low unit stresses in all members.

7. PRESSURE-TIGHT CASING

The all-welded casing forms a rigid, pressure-tight unit that can be arranged for pressurized or balanced draft operation.

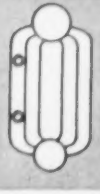
8. MINIMUM REFRACTORY BAFFLING

The wall separating furnace and boiler bank is the only refractory baffling used. It is completely accessible from the furnace.



9. SIMPLE SOOT BLOWER ARRANGEMENT

Soot blowers are supported on the outer row of boiler-bank tubes, simplifying alignment and providing easy access.



FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

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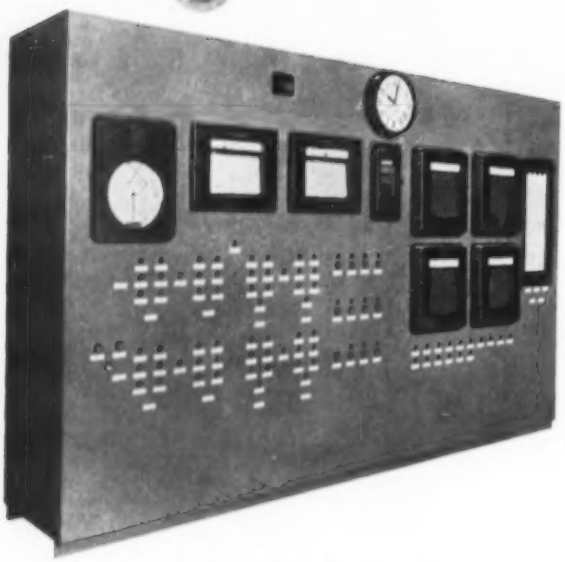
INFILCO DEMINERALIZATION EQUIPMENT...

ENGINEERED to meet YOUR requirements for HIGH PRESSURE BOILER FEED



Control Panel, Commonwealth Edison Company, Will County Station, Joliet, Ill.

- **Maximum reliability**
- **Highest quality water**

Check some of these installations. They are representative of INFILCO's advanced engineering and development in providing water suitable for today's (and tomorrow's!) high pressure steam generators in the utility field.

Alabama Power Company, Gorgas Station ... Gorgas, Ala.
California Electric Company, Highgrove Plant ... Highgrove, Calif.
Commonwealth Edison Company, Crawford Station ... Chicago, Ill.
Commonwealth Edison Company, Will County Station ... Joliet, Ill.
Commonwealth Edison Company, Station No. 6 ... Waukegan, Ill.
Chicago District Electric Generating Corp., State Line Station ... Hammond, Ind.
Interstate Power Company, Dubuque Station ... Dubuque, Iowa
Municipal Gas & Electric Department, Holyoke Plant ... Holyoke, Mass.
Omaha Public Power District, North Omaha Station ... Omaha, Neb.
Central Power & Light Co., Lon C. Hill Station ... Corpus Christi, Texas
Central Power & Light Co., Victoria Station ... Victoria, Texas
Wisconsin Power & Light Co., Rock River Station ... N. Beloit, Wis.
Wisconsin Power & Light Co., Edgewater Plant ... Sheboygan, Wis.

It will pay you to investigate. Write today for Bulletin 1960-C-1.E.

Inquiries are invited on all water and waste treatment problems for all industrial purposes, including boiler feed water makeup, process water clarification and purification, sewage treatment, waste pollution control, material reclamation and related needs.

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REPUBLIC

announces a

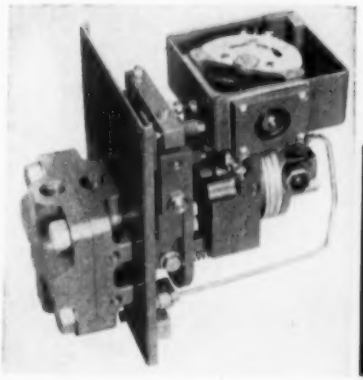
double break-through

in pneumatic transmitter rangeability!

TYPE VP

Pressure Transmitter
Standard Ranges
0-150 to 0-4000 psi
0-60" H_2O to 0-150 psi
0-1½" to 0-60" H_2O

- **Null-balance-*vector* design permits 20-to-1 range adjustment without re-setting zero!**
- **Suppression of range lower limit simply adjusted up to 50% of span!**
- **New compactness and weight saving solve most location problems.**
- **Low air consumption.**
- **Simplified, accessible mechanism for quick and easy servicing.**



TYPE VDP

Differential Transmitter
Standard Range
0-15 to 0-300" H_2O

Republic has *literally* figured all the angles to bring you this new "family" of pneumatic transmitters for pressure and differential pressure. The null-balance-*vector* units are compact, easy to install and adjust, and permit range changes far beyond any pneumatic instruments previously available to industry—and *without changing* parts. You need only a screwdriver and reference gauge to change either the upper or lower range limit!

Adjustment time is radically cut since re-zeroing of the instrument is seldom needed when the upper range limit is changed. Unusually large changes in plant operating conditions can be accommodated quickly and without new or modified equipment, simply by loosening a set screw and moving one linkage component.

Republic Type VP and VDP pneumatic transmitters normally provide standard 3-15 psi output signal pressures. Air consumption is only 0.2 scfm since air flow virtually stops as soon as the transmitter balances each input signal change. And all Republic null-balance-vector instruments have top sensitivity *and* stability. Lightweight tension members in the balancing linkage respond quickly to pressure or differential changes and do not overshoot or "hunt" the balance point.

Whether your plant conditions change frequently or you just want the best sensitivity, accuracy and reliability available in pneumatic transmitters, you should get the full details on Republic Type VP and VDP transmitters.

WRITE FOR REPUBLIC FOLIOS NO. 56-12 AND 56-13A TODAY... and keep an eye on Republic for new developments "in the works" now to help you with your most critical operating instrument problems.

REPUBLIC FLOW METERS CO.

A Subsidiary of Rockwell Manufacturing Company

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For more data circle 524 on Post Card

CONSTRUCTION NEWS

Burbank, Calif. — Municipal Light Department has approved plans and will proceed with work at once on initial unit of steam-electric generating plant. Plant will be installed on municipally-owned site at Olive and Lake Sts at a cost estimated to be in excess of $8,000,000. Work will include installation of steam generator unit, high-pressure boiler, auxiliary equipment.

Riverside, Calif. — California Electric Power Co, 3771 W Eighth St, has arranged for the sale of stock issue in the amount of $4,030,800, proceeds to be used in connection with 1957 construction program including expansion and improvement of company's generating equipment, transmission lines and other operational facilities. Company plans to raise additional funds approximating $6,000,000 through the sale of a bond issue.

Sonoma, Calif. — Pacific Gas & Electric Co, 245 Market St, San Francisco, Calif., has approved plans and work will begin at once on substation installation on local site here. Work will also include the installation of new power and transmission lines for expanded service. Cost reported to be approximately $4,000,000.

Tampa, Fla. — A Florida group composed of Florida Power & Light Co, Tampa Electric Co, and Florida Power Corp, has announced that they are currently discussing with the Atomic Energy Commission, plans for the construction of a 150,000-kw, natural uranium fueled, heavy water moderated, gas cooled reactor scheduled to be completed in 1962. Plans call for the construction of the plant in a fairly desolate area 70 miles southeast of Tampa. The plant will be owned by a new corporation that will issue stock and distribute the reactor's electricity output to the three utilities in proportion to their size as measured by their kilowatthour capacity or annual revenues.

Boise, Idaho — Idaho Power Co, 1220 Idaho St, has announced approval by the Supreme Court of the United States, of company operations now under way on the construction of three small power dams authorized by the Federal Power Commission some time ago. Work is under way in the Hell's Canyon stretch of the Snake River between Idaho and Oregon. The three small dams will generate approximately 783,000 kw of electricity, store more than 1,000,000 acre-feet of water and cost approximately $175,000,000 when completed. The single high dam, backed by public power interests, would have represented an investment of over $400,000,000 with a generating capability of 800,000 kw.

Decatur, Ill. — Illinois Power Co, 134 E Main St, has announced a three-year expansion program of company system. A construction budget of more than $108,000,000 has been authorized for extensions and improvements in power generating facilities for increased output, power substations, transmission lines and other operating facilities; $30,000,000 of the budget will be expended this year, compared with $35,000,000 last year. Company proposes to spend $45,000,000 in 1958 and approximately $33,000,000 in 1959.

Shreveport, La. — Southwestern Gas & Electric Co, 428 Travis St, has arranged financing through the sale of a bond issue to total $10,000,000, majority of proceeds of which will be used for 1957 expansion and improvement program, including increased generating facilities, power substations, transmission lines, etc.

Augusta, Maine — Central Maine Power Co, 9 Green St, is arranging financing in the amount of $18,000,000 through the sale of a bond issue, proceeds of which will be used for major company expansion, including extensions and improvements in generating facilities, transmission lines, power substations and other work.

Salem, Mass. — Five Massachusetts electric utilities filed a merger proposal with the Securities & Exchange Commission. Under terms of the proposal, Essex County Electric Co, this city, would take over Amesbury Electric Light Co, Haverhill Electric Co, Lawrence Electric Co, and Lowell Electric Light Corp, with the resulting company known as the Merrimack-Essex Electric Co. All five companies, members of the New England Electric System, said the proposed merger would result in greater efficiency, economy of operation, and also simplify New England Electric's corporate organization. New England Power Co, Boston, Mass., proposes to sell some of its power transmission facilities to Merrimack-Essex Electric Co for approximately $450,000.

Monroe, Mich. — Power Reactor Development Co, Detroit, Mich., has announced the receipt of the first $2,000,000 installment of a $15,000,000 loan to help finance construction of an atomic power plant here. The total loan which is to be obtained over a two-year period from pension trusts supervised by five New York banks is guaranteed by the 13 electric power companies that are participating members of the Power Reactor Development Co. Project has recently come under the attack of the United Auto Workers (C.I.O.-A.F.L.) Union on the pretense that it will endanger the safety of the residents of the nearby Detroit Metropolitan area.

Syracuse, N. Y. — Niagara Mohawk Power Co, 300 Erie Blvd West, has plans under way for a record expenditure of $94,000,000 on new construction and system improvements through 1957, the largest in the company's history. Comparative figures were $66,900,000 expended in 1956 and $14,500,000 in 1955. Company forecasts for 1957 envision 22,000 new electric customers and an increase in the consumption of electricity and power of better than 5 per cent over last year. Utility expects to double its electric and gas sales in the next 10 years and by 1960 expects to have a system generating capability in excess of 3,500,000-kw compared to 2,600,000 at the present time.

Gaston, N. C. — Virginia Electric & Power Co, Seventh & Franklin Sts, Richmond, Va., has plans under consideration for the construction of new hydroelectric station on the Roanoke River on plant site recently acquired near here. Installation will have an initial capacity of 87,000-kw and will take about three years to construct. Project to cost an estimated $32,000,000 will get under way as soon as approval is granted by the FPC.

Dayton, Ohio — Dayton Power & Light Co, 25 N Main St, has arranged financing through the sale of a stock issue of common stock, to total about $15,000,000, majority of proceeds to be used for 1957 expansion and improvement program, including expansion and improvements in generating facilities, power substations, transmission lines and other corporate improvements. The balance of the proceeds will be used to pay off certain short term bank loans incurred in the expansion program.

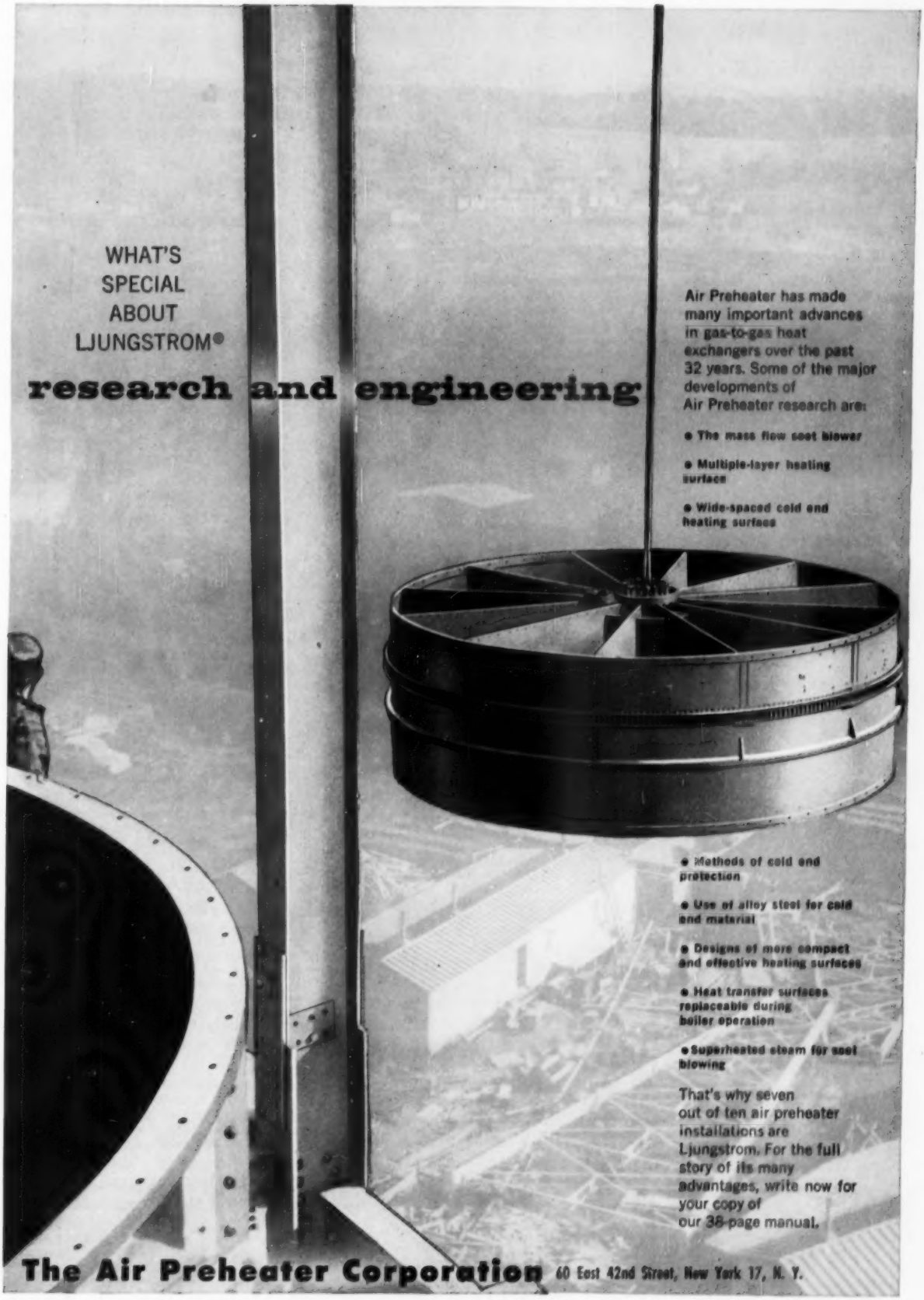
Dallas, Tex. — Texas Utilities Co, Interurban Building, has announced plans for the construction of property additions in the 1957–1959 period, including $79,000,000 for 1957, to total approximately $267,000,000. Most of the money expended will go toward new generating capacity with a program that calls for the addition of 908,000 kw of new generating capacity, including 125,000 in 1957, 408,000 in 1958, and 375,000 in 1959. In addition, 415,000 may be added in 1960 to meet anticipated growth should it be required.

San Antonio, Tex. — Public Service Board of the City of San Antonio, Navarro and Vilita Sts, in line with approved plans for new additions and improvements to municipal power plant and system has arranged financing in the form of a bond issue of $20,000,000, proceeds of which will be used for this work.

Magna, Utah — Utah Copper Division of Kennecott Copper Corp, Kearns Bldg, Salt Lake City, Utah, has approved plans for a major addition to company's power and generating facilities at local copper mine in Magna. Installation of a 75,000-kw steam-electric generating unit will begin at once and is scheduled for completion by early 1959. Total cost of additional installation and auxiliary equipment reported in excess of $16,000,000.

Richmond, Va. — Virginia Electric & Power Co, Seventh & Franklin Sts, is currently engaged in an expansion program which will add 750,000 kw of generating capacity to company system by 1959. Company is also planning another hydro-electric station with an additional 87,000 kw of capacity. Company expenditures in this regard will exceed $70,000,000 for 1957, up from $44,500,000 last year. Company has arranged for the sale of two security issues this year to arrange for financing of company projects which will bring in about $42,000,000. When current expansion program is completed in 1960, company's system-wide capacity will be 1,900,000 kw, up from present capacity of 1,150,000 kw.

Cresap, W. Va. — Four companies, namely Olin Mathieson Chemical Corp, Baltimore, Md., Ohio Power Co, Canton, Ohio, Revere Copper and Brass, Inc, New York, N. Y., and Wheeling Electric Co, Wheeling, W. Va., have approved plans for the construction of a new power plant near Cresap. Installation will have an initial capacity of 675,000 kw, and will supply power for a vast aluminum reduction and fabricating plant to be built in the area. Two units of the plant will be owned by Olin Revere Generating Corp, representing approximately two-thirds of the initial kilowatt capacity. Ohio Power will own and operate the third unit. Cost of installation while not announced is expected to represent a multi-million dollar investment.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LJUNGSTROM®
research and engineering
Air Preheater has made many important advances in gas-to-gas heat exchangers over the past 32 years. Some of the major developments of Air Preheater research are:
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• Multiple-layer heating surface
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That's why seven out of ten air preheater installations are Ljungstrom. For the full story of its many advantages, write now for your copy of our 38-page manual.
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EQUIPMENT NEWS

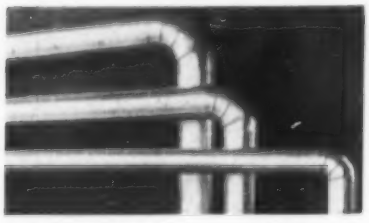
Described on these pages are new and improved products. Use Reader Service Cards on pages 97–98 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

1—SAFETY SOLVENT has no flash at boiling point

Safety Solvent SS-25 is announced as approximately 25 times safer than carbon tetrachloride. It has no flash at boiling point, company says, and is a safe replacement for many inflammable petroleum solvents. According to manufacturer, it is corrosion free, leaves no residue, is safe for all surfaces, and has never been found to contribute to dermatitis. SS-25 is suggested for cleaning and degreasing electric motors, electric and mechanical parts and equipment. It is also used for cleaning electronic parts and components, and is said to remove finger prints on electronic parts. Company says it will not harm rubber or enamel insulation, and may be applied by hand or air sprayer, brush, or by wiping. National Disinfectant Co.

2—ALUMINUM JACKETS protect insulated elbows

Announced as an economical solution to the problem of protecting insulation on elbows, Ell-Jackets are deep-drawn from 0.020 in. aluminum, No. 3003 alloy. They are designed to cover and



protect insulated elbows and are made for both 90- and 45- deg ells, and have factory-applied moisture barrier. The two-piece Ell-Jackets are precision formed to fit snugly over the elbow, says manufacturer, and they afford weathertight protection. They are applied with aluminum sheet metal screws and no special tools are required. Ell-Jackets come in 23 sizes for 90-deg ells, and 23 sizes for 45-deg ells to cover all lines having a 1½ to 10 in. nominal pipe size and insulation from 1 to 3 in. thick. Childers Mfg. Co.

3—MOTOR BASE compensates for belt tension

This tilting motor base is claimed to pull double duty with any variable speed pulley. The base compensates for belt tensions when speed changes are made while the machine is running, company explains, and it also makes belt changing easier. The unit features one size base for all fractional horsepower motors. Because of its tilting movement it requires only minimum space for adjustment. Actual base size is 5½ by 7½ in. Correct belt tension and alignment are maintained by a handwheel screw adjustment. Lovejoy Flexible Coupling Co.

4—DEMAND METER KIT for making load surveys

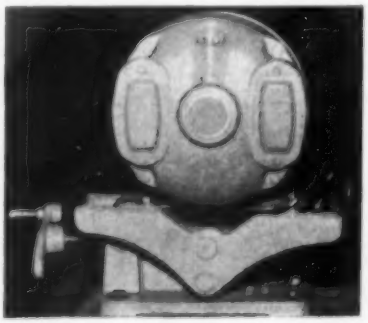
This demand meter kit is announced for use by utilities in making load surveys on feeders for planning guidance. Easily mounted on company's distribution voltage regulators, meter responds to heating effect of load in amperes — the limiting factor of the circuit capacity. A current transformer which steps up control current to desired meter current is mounted inside the meter. This current transformer has two taps which make it possible to read either 3-amp or 6-amp full scale deflection. Taps can be changed by two metal strips on rear of meter. Allis-Chalmers Mfg. Co.

5—SMALL COMPRESSOR supplies oil-free air

The CACB Model is designed to provide oil-free air for the operation of instrument controls, as well as for use in food processing, brewing, distilling, paint spraying and other applications. The heart of the space-saving compressor is said to be in the carbon parts in the cylinder which require no oil or water lubrication. The CACB is a single-stage, air-cooled unit available base or tank mounted. It supplies 4 to 5 cfm of oil-free air, and is suitable for discharge pressures of 40 to 100 psi. Automatic start and stop controls are supplied as needed. Gardner-Denver Co.

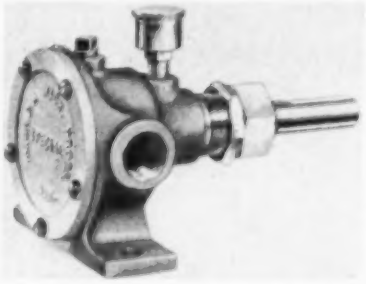
6—O-RINGS are suited for dry heat service

Red silicone rubber O-rings, Style 9599, are made from 70 durometer hardness stock exhibiting low shrinkage and compression set, it is announced. They are suggested for dry heat service on which many synthetic rubber compounds and natural rubbers do not maintain their rubber characteristics. According to manufacturer, these silicone rings resist oxidation, withstanding indefinitely continuous exposure to hot air and temperatures to 300 F; in most applications they will withstand, for long periods exposure to dry heat at temperatures from 300 to 500 F. They come in standard AN sizes. The Garlock Packing Co.



7—NEOPRENE IMPELLER PUMP has cost saving features

The K½ Special is self-priming and operates quietly and effectively in either direction at low or high speeds, manufacturer announces. It is believed to be the first Neoprene impeller model in ½ in. IPS designed to operate off a motor



as small as ⅓ hp single phase. Made of Naval bronze, with a stainless steel shaft, it handles liquids that do not affect bronze or Neoprene, at 7½ gpm, 10 psi at 1750 rpm. The small initial cost of this pump (less than $17.00) together with the fact that it can utilize a low-priced, low-operating cost motor, makes it an economical unit for low pressure use of not more than 10 psi. American Machine Products, Inc.

8—CORROSION INHIBITOR for cooling tower systems

Nalco 360 is basically a chromate type material to which other inhibitors, each exerting a synergistic effect on the others, have been added. The resulting combination is said to provide better corrosion control than any of the several inhibitors used alone. It is claimed effective over a relatively wide range of pH conditions. Nalco 360 is produced in 3-in. diam ball briquettes, about 1 lb in weight. To apply the chemical a simple by-pass feeder is normally used. Cooling water passing through the feeder dissolves the ball briquettes and carries the solution of chemical treatment back into the cooling water line. Or the briquettes are merely dissolved in a wire basket suspended in the cooling tower basin. Nalco 360 is applicable to a variety of cooling waters, it is noted, but should not be used to treat potable waters or in installations where contamination of potable waters might occur. National Aluminate Corp.

9—CENTRIFUGAL PUMPS, high capacity, for severe services

For capacities up to 25,000 gpm in the petroleum, pulp and paper industries and municipal water works, the 24-in. Fig. 3420–3423 Pumps are introduced. The two units differ only in the lower

Crane Stop-Checks Mean Safer Boiler Operation

This valve cost-free for quarter century

Gate, globe, angle or stop-check—Crane steel valves are hard to beat for low-cost service on steam.

This is proved again on the installation at Scott Paper Company's West Coast Division at Everett, Wash. This Crane 300-pound stop-check has been on one of its boilers since the pulp mill was built in 1929. Working pressure: 250 psi at 450 deg. F.

Not until 1954 did this Crane No. 30XU valve need any repairs—after 25 years of steady operation with just routine maintenance. Now with new parts, it's ready to set another such record.

A single moving part: the disc—with chatter-free throttling lip—and effective disc cushioning—is one of the many reasons why Crane stop-checks have racked up this kind of service record in installation after installation. Ask your Crane Representative for full details, or write to address below.

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half casing. Fig. 3420 has horizontal suction and discharge; Fig. 3423 has vertical bottom suction and horizontal discharge. These single-stage, double-suction pumps have horizontally split casings with upper and lower half bolted and dowelled together. Removal of upper half casing permits inspection and removal of entire rotating element without disturbing suction and discharge piping or pump and driver alignment, it is noted. The pumps have renewable type casing wearing rings to maintain proper running clearance with impeller hub and to minimize leakage between suction and discharge chambers of casing. Goulds Pumps, Inc.

10—TIME SWITCH for intermittently operated equipment

Completely automatic control of intermittently operated equipment is provided by this 24-hr time switch, it is announced, which will handle as many as 48 "on" and 48 "off" operations in one day. Typical applications include heating and air conditioning equipment, stokers, oil and gas burners, etc. A control dial, scaled in 15-min graduations is used to set up a daily operating schedule. Running periods are set by sliding self-contained, non-removable trip levers in or out on the dial. Switch will repeat entire schedule automatically each day. A calendar cutout device to make switch completely selective for all seven days is available as an accessory, making provision for non-working days. Mechanism is powered by a heavy duty, synchronous industrial motor. Capacity is rated at 1000 w using 60 cycle a-c current. Zenith Electric Co.

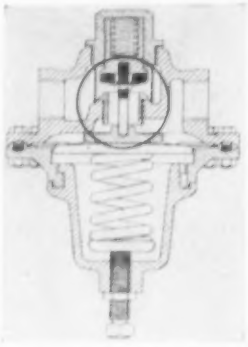
11—PVC PIPE UNION now available in 3-in. size

This 3-in. screwed pipe union, made of corrosion resistant rigid polyvinyl chloride, increases PVC piping application possibilities, it is announced, which have been limited by the availability of only smaller sized unions. PVC piping sys-

tems are used to handle corrosive fluids in food and chemical processing industries, refining industry and in the paper and marine fields. Specially designed surfaces in joints of 3-part union provide a tight seal against flow leakage. The PVC material is described as exceptionally resistant to most salts, alkalis and acids at temperatures as high as 150 F, and equally resistant to corrosive elements in industrial atmospheres and operations. Weighing about 1½ lb, union is easily handled and installed, company says, and is available with threaded or solvent-weld socket-type ends in either high- or normal-impact polyvinyl chloride. Walworth Co.

12—REGULATING VALVE offers higher capacity

Described as an improved pressure regulator, this valve incorporates a larger through passage which gives a greater capacity and also a less turbulent flow



pattern through the valve. Construction is simpler, says manufacturer, and valve discs are interchangeable. Thus, you can switch quickly from water service, for example, to steam, gas or air — by simply removing one disc and substituting a disc for the service desired. There is also an added safety factor, it is noted, because the spring adjustment is made from below. Reduced pressure range is from 1 to 100 psi, depending on size of valve, with initial pressures as high as 400 psi. The unit has a built-in strainer. The valve can be had in bronze, semi-steel, or steel body with alloy trim, if desired. Six standard sizes range from ⅜ to 2 in. Davis Regulator Co.

13—PYROMETERS are designed for reading accuracy

According to manufacturer, these indicating pyrometers may be read more accurately from all angles because they have been redesigned with mirror scales to cut down parallax effect. They are medium resistance pyrometers (4 ohms per millivolt) available in 21 standard ranges. Maximum sensitivity for a pyrometer connected to one thermocouple is 300 F for full scale deflection, company states, and standard ranges begin with −400 to 100 F and go up to 0 to 3000 F. Full scale accuracy of 2 per cent is reported standard, although 1 per cent is offered at extra cost. Pyrometers may be thermistor-compensated to maintain accuracy in spite of ambient changes. They are furnished with compensation for changes in cold junction. Styles available include panel mounting, portable and bench models. Meters are available in widths of 3¾ and 4½ in. Assembly Products, Inc.

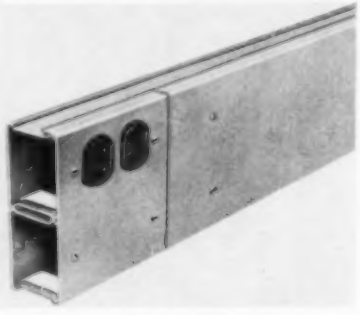
14—PARSHALL FLUME METER requires little maintenance

Designed for accurate measurement of sewage flow, the ML Parshall Flume Meter is said to require little or no maintenance and permit worthwhile savings in construction costs. It is so constructed as to eliminate use of a stilling well and cover, connecting pressure piping and fittings, cleaning valve, back flushing requirements, and float cable. It is reported to remain virtually deposit-free.

Features of the unit include a 4-in. diam stainless steel float and float rod, and a core and coil transmitting device mounted in a waterproof casting which is attached to the side of the flume or suspended from or attached to a cross piece at the flume's entrance. The float rides on the surface of the water, being immersed only ½ in. Consequently ⅞ of the float is out of the water and any sewage, rubbish and debris can ride through the flume without being engaged with the float itself. The recording meter can be installed anywhere up to 3500 ft from the flume. Transmission is continuous, of the null balance inductance bridge type, requiring just three twisted insulated and shielded wires to the receiver, and with power necessary at the receiver only. Installation of the meter, after construction of the flume, is said to require only a day's time. Flow is recorded on a 12-in. diam chart for daily or weekly removal. Penn Instruments Div., Burgess-Manning Co.

15—RACEWAY carries high and low conductors

Twinduct is a metal surface raceway designed to carry both high and low potential conductors in a single run. Engineered into Twinduct are features of company's Surfaceduct, a 2-by-2 surface raceway designed to service loads falling within the range of No. 6 AWG conductors. Main difference between the two products is that Twinduct offers two

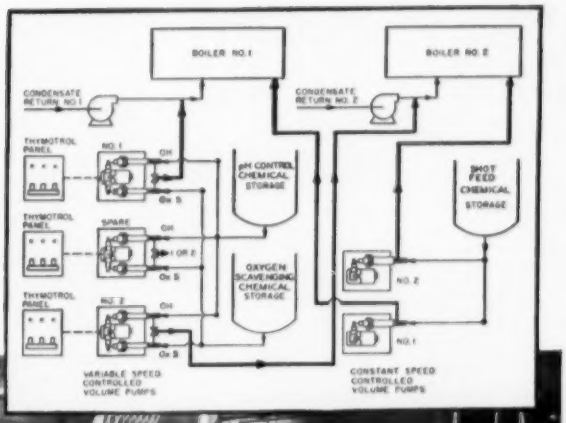


separate 2-by-2 raceways with a single screw-on cover. Twinduct incorporates the "lay-in" principle of wiring. It is noted that because of its design, a maximum amount of unobstructed space is retained inside the raceway for installation of conductors. This is made possible by a bridge which retains wires during installation, holds the capping and serves as the method of installing devices.

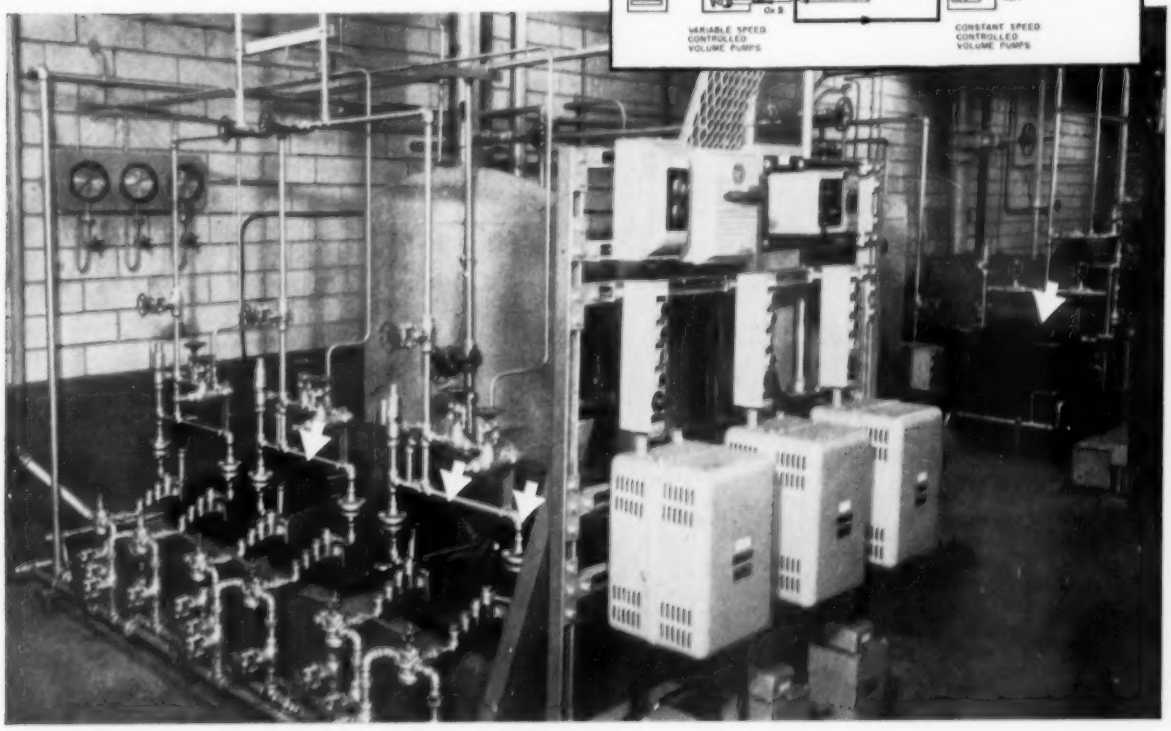
Covers are available to adapt to approved outlet devices up to 20-amp capacity. Without devices, the system becomes an economical and efficient duct, manufacturer states. Twinduct is finished in a satiny gray, comes in 10-ft lengths with ½- and ¾-in. knockouts and mounting holes on 15-in. centers in the base. Bridges are furnished with each 10-ft section of Twinduct. National Electric Products Corp.

16—SIGHT GLASS also serves as moisture indicator

The Super Dry-Eye is a refrigeration servicing instrument designed to enable detection of basic refrigeration system trouble in its earliest stages. It is a T-shaped brass fitting, similar in size, appearance and price to company's regular Dry-Eye, introduced previously. However, where the latter offered only



Boiler water treatment installation of Controlled Volume Pumps at a major utility.



Save chemicals in boiler water treatment with Controlled Volume Pumps

Controlled Volume Pumps efficiently deliver the small quantities of treating chemicals required to protect boilers from scale, embrittlement, corrosion and pitting. They meter and pump chemicals in measured volumes directly into high pressure feedwater lines . . . within an accuracy of ± 1%.

The accuracy of Milton Roy Controlled Volume Pumps puts chemicals to work in the *exact* quantities required . . . keeps chemical consumption at a minimum.

Milton Roy designs and fabricates complete packaged systems for the treatment of boiler feedwater. Check with your water treatment specialist for the system best suited to your station.

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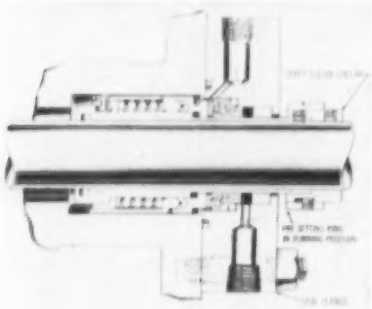
one moisture indicating element, the Super Dry-Eye has two: one for Freon-12 and another for Freon-22, plus a built-in sight glass. The indicating element for Freon-22 shows blue when the refrigerant is dry and in safe operating condition (when moisture content is below 10 ppm). When this element turns pink, the refrigerant is dangerously wet (above 30 ppm). For Freon-22 the element is green when dry (below 20 ppm) and pink when wet (above 25 ppm). The circular fused glass window through which moisture indicating elements are visible also serves as a sight glass. Bubbles in the flowing refrigerant indicate a low refrigerant charge or a restriction in the line. Ansul Chemical Co.

17—MECHANICAL SEALS have special fitting feature

Perfect mechanical seal installation without measurement is claimed "built in" with BJ Mechanical seals with Pre-Setting Ring feature. Manufacturer says that anyone with simple hand tools can install or replace these seals without taking measurements or referring to installation drawings. This development



provides a seal assembled as a cartridge unit ready for installation. The pre-setting ring is attached to the shaft sleeve collar with a set-screw in a slot of controlled length. The "packaged" seal is slipped onto the shaft and into the stuffing box. The seal flange is bolted to the stuffing box and the collar fastened to the shaft. The ring is then moved the length of the set-screw slot and locked in place. This places the seal in precise running position, it is pointed out, with the spring compressed to proper tension. This feature is reported of particular importance to users of two-bearing pumps, such as horizontal pipeline and boiler feed pumps, and vertical pumps requiring impeller adjustment. Byron Jackson Pumps, Inc.

18—GEARED THREADER is lighter, easier to use

Using special aluminum castings, the Beaver 41-E Geared Threader has been reduced in weight by about 40 per cent, it is announced. It is an adjustable threader for use by hand or with power drives. The threader uses only one set of dies for the full range of 2½, 3, 3½ and 4 in. The die cam may be set to cut standard, deep, or shallow threads of standard length. Both straight conduit and tapered threads can be made with the same set of dies by making a quick, simple adjustment. This threader is available in either American or British right-hand threads, plus special oil field threads. Beaver Pipe Tools, Inc.

19—BREAKER LOAD CENTERS with "snap-out" interiors

Spring mounted interiors which can be snapped in or out in seconds and provide automatic front alignment even when a flush load center box is installed off plumb are announced as available on this company's circuit breaker load centers. A feature claimed for the "snap-out" interior is that it speeds installation and eliminates flush adjustments. With the interior removed, the whole inside of the load center box is free for hammering or screwing the box to a stud. There is also more room for pulling wires and installing cable connectors, company points out. Circuit breakers with this type of interior come in ratings from 70 throuh 200 amp, with flush or surface fronts, and from four to 30 circuits. General Electric Co.

20—INDICATING CONTROLLER, mercury-actuated, air-operated

Available in two basic types, "on-off" fixed high sensitivity or proportional band, this controller can be changed from direct to reverse acting — or vice-versa — without tools. The fixed high sensitivity controller is normally used on batch type processes, where "on-off" valve cycling is satisfactory — usually where there is a large demand or load, and small supply. It can be used efficiently on a wide range of industrial applications. The proportional band type offers throttling control for continuous flow processes, where cycling and over-shooting cannot be tolerated, and is reported particularly adaptable to applications having variable time lags and capacities, and where load changes are not frequent. It features wall mounted cast aluminum case with bottom outlet, standard ranges to 800 F, and is furnished with 5-ft heavy, flexible bronze connecting tubing, ¾ in. NPT chrome plated fittings, and stainless steel bulb for liquid immersion. Controller is also available in a recording type model. H. O. Trerice Co.

21—SPEED TRANSMITTER is pneumatic and linear

Described as a departure from conventional speed transmitting devices, the Type 16A Pneumatic Speed Transmitter produces a pneumatic output linearly proportional to rotational speed. It is designed to measure speed of rotating machinery and reported particularly applicable to turbines, conveyor lines, compressors and mill equipment. It operates on the force balance principle with magnetic actuation of a standard pneumatic circuit.

This transmitter is small, light and easily installed, says manufacturer. Gasketed construction and continuous air bleed prevent dust and weather damage, it is pointed out, and no electrical hazards are present. Effect of ambient temperature on magnetic field strength is compensated by the bi-metallic input shaft which automatically varies the spacing between magnet and disc with temperature changes. Transmitter range is adjustable from 0 to 1630 rpm up to 0 to 2400 rpm by a fine range adjustment screw and extended to 0 to 320 rpm through 0 to 5300 rpm by optional speed changers. The instrument can be assembled to measure clockwise or counterclockwise rotation, or 3–15 psig output can be split for both forward and reverse rotation. The Foxboro Co.

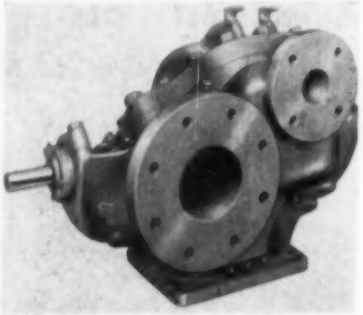
22—INSERT FLANGES repair stainless process piping

Speedline Insert Flanges are designed to enable tying in of new equipment and breaking into existing lines and headers without resorting to welding. Press fit

between insert and flange assures that pipe or fitting can be expanded into the ferrule permanently, it is stated, and further facilitates usage in that only one piece has to be handled. The "tangential" feature (extra straight section) on these flanges permits attachment by simple expanding operation. There is said to be ample clearance to permit flanging of one or all parts of fitting without fouling. Horace T. Potts Co.

23—CENTRIFUGAL PUMPS for many applications

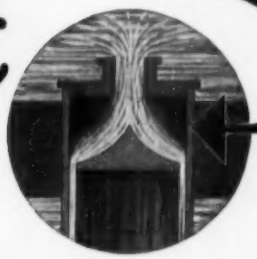
These diagonally split case centrifugal pumps are suggested for boiler feed service, and hot or volatile liquid applications requiring low NPSH characteristics. While retaining advantages of



horizontally split case pumps, these embody some advantages inherent in the 45-deg casing split, says manufacturer. Features in common with horizontally split case pumps include ability to remove the entire rotating element without disturbing piping or pump-motor-base alignment. The 45-deg split allows both the suction and discharge to be located in the bottom half of the casing but above the center line of the pump.

Dirty Water can't "Shut-down"...

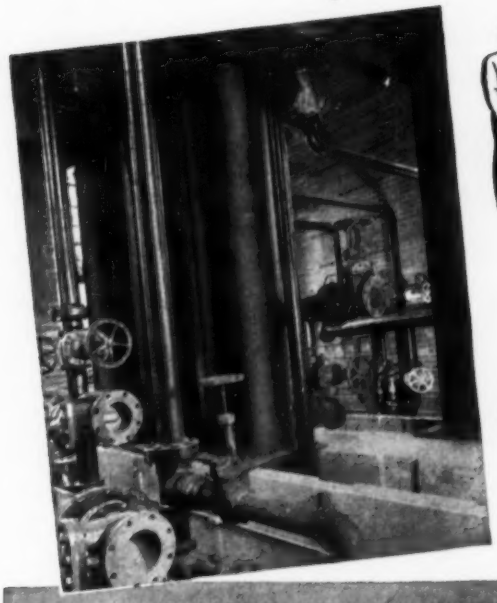
Vogt

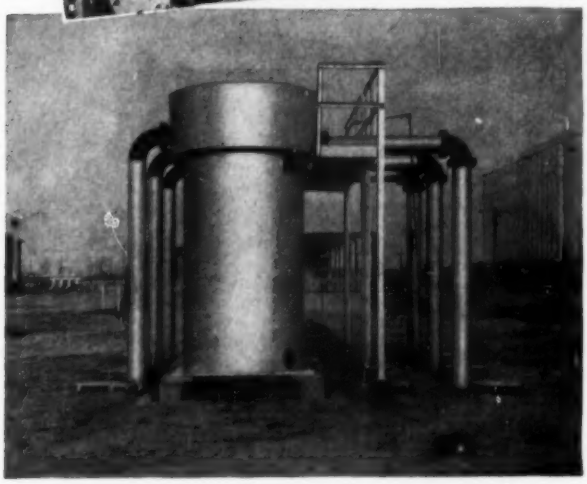


film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441





River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request. Dept. 24A-XPE]

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Type A — Point-of-use Separators on service outlets in plant systems, on portable compressors. Sizes: ⅛" thru 2".

Type C — Main Line Separators equipped with shut-off cock for removal of screen for cleaning without interruption to operation. Sizes: ½" and up.

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These pumps are self-venting and will not vapor lock, it is pointed out, thus the need for bleeding back to the feedwater heater or receiver is eliminated. The pumps have as standard, 125-lb ASA suction flange and 250-lb ASA discharge flange. They are usually bronze fitted, but can be furnished all-iron or stainless steel trim for high temperature conditions. Aurora Pump Div., The New York Air Brake Co.

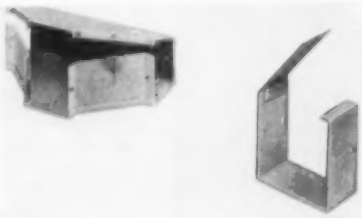
24—MINIATURE NUT DRIVERS for instrument repair jobs

These nut drivers start where normal-size ones leave off and go down to the

No. 00 hexagon nut. Sizes available in the line are (measuring across the flats) 3/64, 7/32, 7/32, 1/8, 5/32 and 3/16 in. They are about 2½ in. long. The miniature drivers come in sets containing their individual permanent plastic handles, and also in replaceable sets with a swivel type jeweler's handle. Hunter Tool.

25—ELECTRICAL WIREWAY is flangeless, "lay in" equipment

Wire can be assembled and laid in after the wireway is installed, with Boss Lay-In Electrical Wireway and Fittings. The line of flangeless hinged-cover



equipment is designed to eliminate wire pulling and risk of damaging insulation. Three sizes of wireway are available: 2½-by-2½ in., 4-by-4 in., and 6-by-6 in. Lengths of 1, 2 and 5 ft are included. The flangeless units have firm, but easy knockouts and full length covers, it is noted, and sections can be easily clamped together by a U-connector, or can be attached to flanged wireway by means of an adapter. Accessory fittings offered include U-connectors, 45- and 90-deg elbows, T-fitting pull boxes, closing plates. The Huenefeld Co.

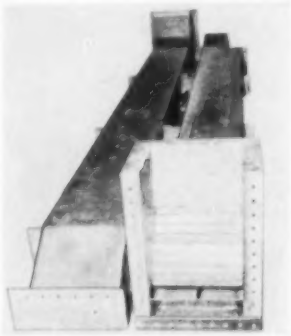
26—BRACKET-LINKAGE for use with butterfly valves

This bracket and linkage arrangement for butterfly valves is reported to simplify their hook-up with automatic control operators and offer advantages in operation, adjustment and maintenance — as well as reduce power requirements in close control operations. The arrangement has rod end bearings which allow for lateral movement of the linkage, necessary in changing from straight line to rotary motion. Thus, it is stated, an almost friction free connection is provided between the operator stem and valve shaft. There is no chatter or hunting, even when throttling the valve disc under critical control conditions, says manufacturer.

The cast bracket, now available for mounting diaphragm type air operators of all sizes, is designed to prevent distortion or binding of linkage. Its design permits reversibility of action, after the valve has been in service, without additional parts. The same arrangement may be used with suitable extension for valves mounted in vertical or horizontal pipe line. Manufacturer says the bracket and linkage is standard for butterfly valves up to 48-in. pipe size, in accordance with torque. W. S. Rockwell Co.

27—VANED DUCT SECTION for corrosion resistant systems

Development of a vaned 90-deg elbow for incorporation in corrosion resistant fume duct systems is announced. Company states that vaned sections can



be made available for rectangular and circular systems to cut down turbulence and speed flow for any angle turns. Manufactured of polyester glass reinforced plastic, these ducts are said to offer a high corrosion resistance with extreme light weight construction. Field assembly by means of bolted flanges or by field welds offers erection ease and speed, and net installed cost is claimed to be lower than for many systems offering comparable corrosion resistance. Haveg Industries, Inc.

28—CONTROL MOTOR operates valves and dampers

The Actionator is an electric motor designed to operate rotary, slipstem and butterfly valves, dampers and other final elements in automatic control systems. A reversing capacitor type, this motor comes in two models, one for two-position and floating control, and the other for proportioning control. The units are compact, about 6 in. diameter and 10 in. wide, and they weigh 11 lb. They incorporate a gear train that permits a selection of timings from 7.5 to 120 sec., depending on model.

To prevent "coasting" in any of the positions, the units have a built-in internal brake capable of holding a dead-weight load up to 200 lb. Limit switches, which can be adjusted in the field, vary the travel. Enclosed compartments can accommodate up to 16 terminals.

These facilitate retransmissions, operation of a second motor or the remote indication of control element positions. The motors are designed to operate under temperature conditions from 25 to 150 F. Ratings are 115 or 208 v at 60 cycles, and 230 v at 50 or 60 cycles. Minneapolis-Honeywell Regulator Co.

Described on these pages are new and improved products. Use Reader Service Cards on pages 97–98 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

29—CHAIN DETACHER works easily and quickly

This chain tool detaches ASA roller chains in seconds, with equal ease, it is announced, whether on the bench or in the field. A complete pin link is detached

through the medium of the threaded stud, which exerts pressure evenly on both pins. This steel detacher merely requires placement of the roller chain in the saddle and the tightening of a nut. There is no distortion or damage to roller chain in detaching process, company notes, and therefore, no loss of parts — the link, rollers and side bars may be reused. Tool is available in two sizes for use with No. 50 and No. 60 roller chain. Helix Corp.

30—SWITCHBOARD INSTRUMENT designed for easy reading

Said to surpass ASA readability standards by 200 per cent, this instrument is engineered for easy reading at better than 120-deg angle. It is declared particularly useful for installations where distant angular readings must be taken and legibility is essential. Its increased angle of readability suggests its use on swinging brackets or installations necessarily remote from the observer. Switchboard instruments with the improved angle of readability include voltmeters, ammeters, wattmeters, frequency meters, power-factor meters, varmeters, synchroscopes, temperature meters and ground detectors.

Manufacturer points out that standard ASA specification for angles of readability in switchboard design is ± 20 deg; this new design offers legibility at ± 60–65 deg. Construction is such as to eliminate cover overhang, a frequent cause of scale shadow, it is noted; and to eliminate parallax errors, the instrument scale is designed so that the tapered pointer tip is in the same plane as the scale markings. The convex-type, anti-static, lime glass cover serves to present a minimum of flat surface and reduce glare from angle lighting. The instruments are shielded from external magnetic fields. General Electric Co.

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VALVE-IN-LINE
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will enable you to set up an effective valve maintenance program

FOR GATE TYPE VALVES
Dexter Gate Valve Reseaters are power driven through a chain and sprocket transmission. Grinding head located on a universal joint automatically seeks and holds the plane of the valve seat, regardless of its angle. Size range: 1" thru 12".

FOR GLOBE VALVES
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- Reseat in the line 3 to 4 valves in less time than it takes to remove, cut, lap, replace one valve.
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- Perfect for welded-in valves.

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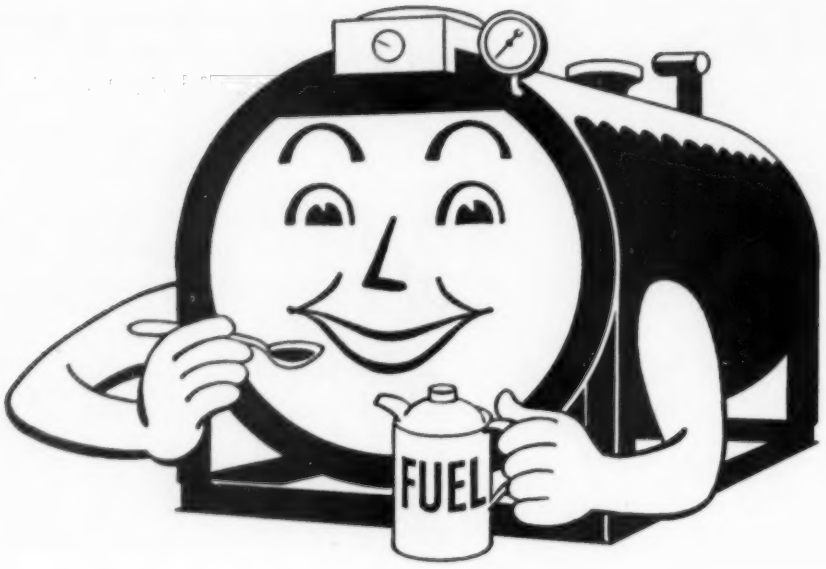

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Every Continental Automatic Boiler – in sizes from 20 to 500 hp – has a guaranteed efficiency of more than 80%. As an engineered product, all its parts function smoothly together . . . give quiet, low-cost operation . . . vibration-free performance. For more details, send for Bulletin BE-3.

BOILER ENGINEERING & SUPPLY COMPANY, INC.
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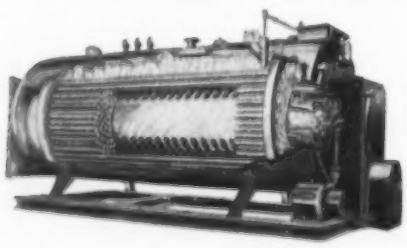
The **Continental** AUTOMATIC BOILER



(Left) Series F Continental Automatic Boiler, with modulating control. Other models from 20 to 500 hp, with on-off or modulating controls, burn oil and/or gas. For steam heating or process work at pressures from 15 to 250 pounds, or for hot water heating at low or high temperatures.

A HALF CENTURY OF BOILER MANUFACTURING EXPERIENCE

For more data circle 531 on Post Card

New Edward Instrument Valve *with integral hard-faced seat ends corrosion-erosion problems!*

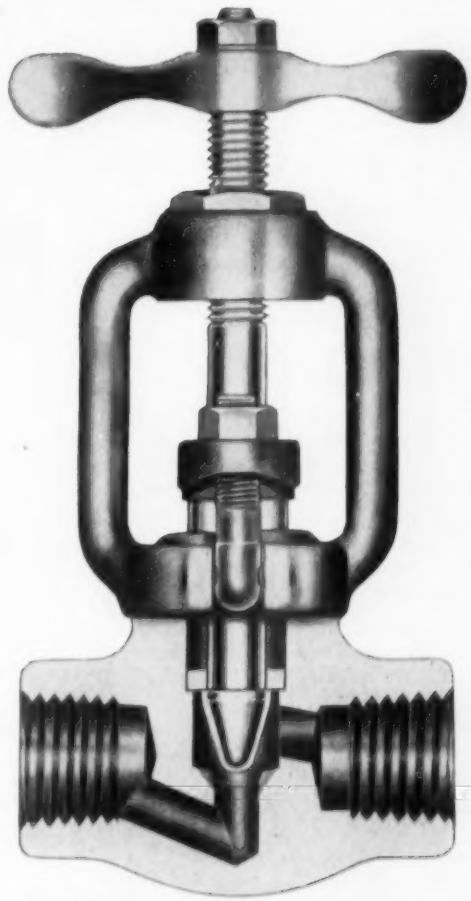


Fig. 952

Used to be, you had to choose between valves of stainless steel—which were difficult to weld into carbon steel pipelines—and valves of carbon steel, which soon corroded and began to leak around the seat. Scientists in the Research Laboratories at Edward Valves, Inc., have been hard at work on this common, costly, irritating problem. And—as usual—they have come up with the solution.

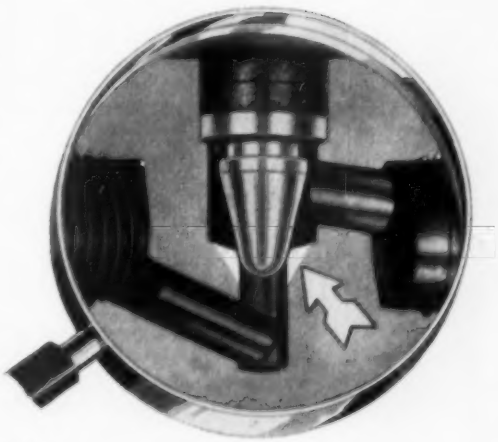
Valve seat now hard-faced with cobalt-chromium-tungsten alloy

This new Edward instrument valve combines a carbon steel body with a cobalt-chromium-tungsten seat face for long, dependable, corrosion-resistant life. *The seat is integral with the body to eliminate leak problems.* Precision machining of the alloy seat—in the same set-up as the body bore—is followed by careful lapping to form drop-tight mated seating faces with 100% bearing surface. The carbon steel body permits easy, efficient welding into carbon steel pipelines. Screwed ends are also available.

Precise flow control

Precise flow control is achieved by tapered needle point stem disk and fine pitch screw threads. This new Rockwell-built Edward instrument valve meets the need for a small, compact stop and variable flow valve for high-pressure, high-temperature service. Rated at 2500 lb. at 850F., the new valve is ideal for all power plant instrumentation. The stainless steel body line will continue in production for applications requiring extreme corrosion resistance.

For further information on the new Edward instrument valve, write for Bulletin 571.



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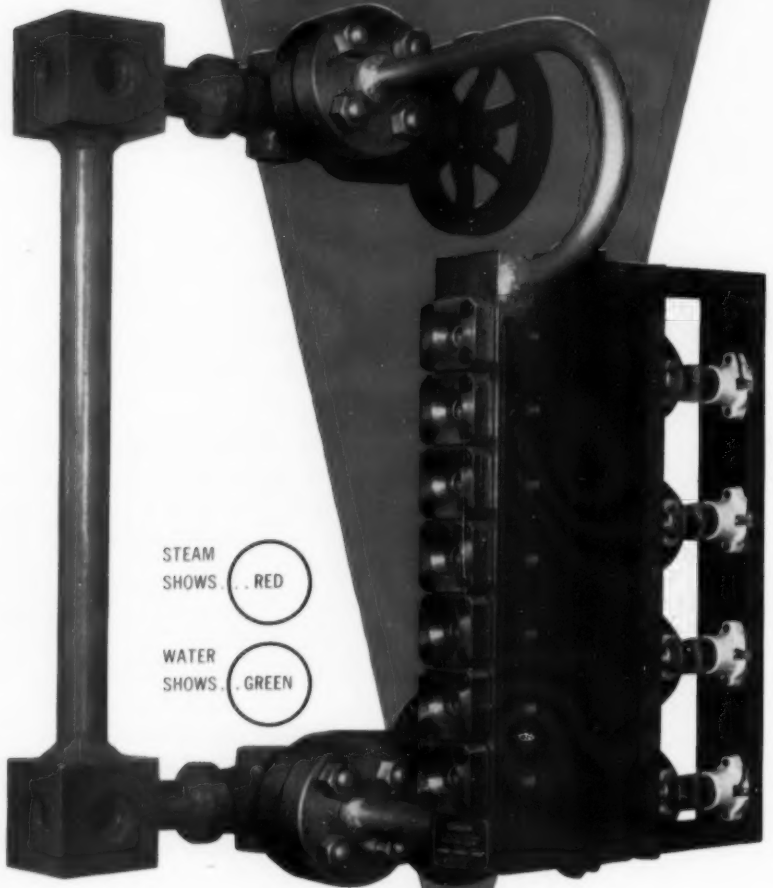
Two-color readings are brilliant and clear. Water shows green; steam shows red. A full gage is all green and an empty gage all red.

Low maintenance with individual cover-glass assemblies, each held solidly in place by four socket head cap screws. "Floating assembly" design applies safe, predetermined loads on glass ports, reducing thermal shocks, permitting faster warm-up.

Increased availability means longer service life. Cover glass assemblies can be *serviced in place*, easily and quickly.

Yarway Bulletin WG-1814 describes the Color-Port Gage. Write for it.



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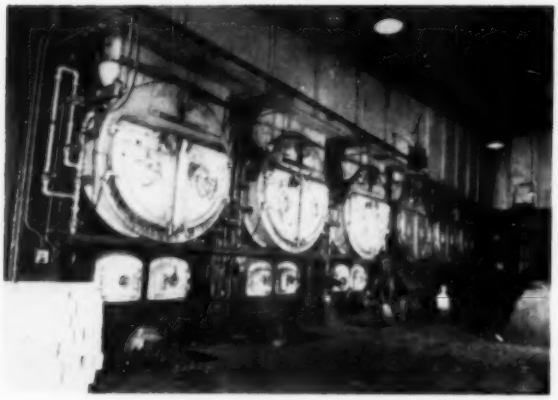

Modernizing Small Industrial Power Plants

By H. D. FISHER*

This is the third of six case histories to guide your future planning. First two cases appeared in May and June issues. No. 4 appears next month

WHAT DID IT COST TO MODERNIZE PLANT C?

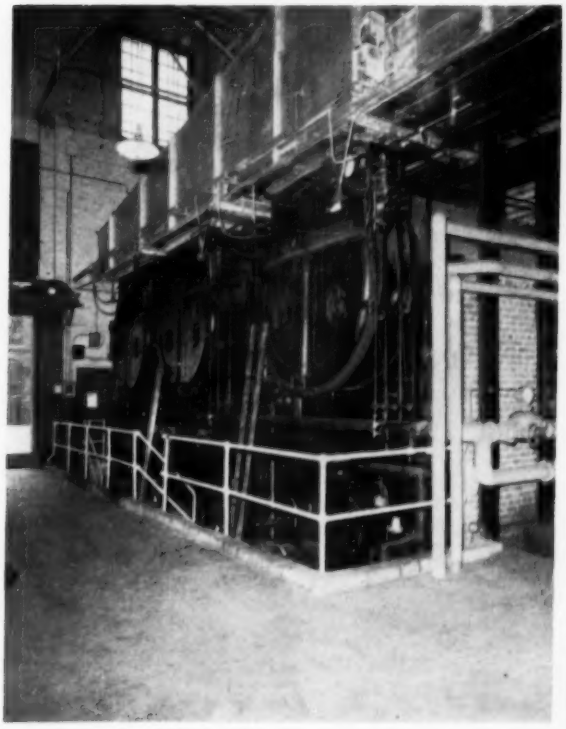

Fig. 1 (Top). Boiler plant C before alterations had 6 78-in. hrt boilers dating from about 1910, of riveted construction

Fig. 2 (Above). View of new boiler installation from opposite side of room. Units develop 15,000 lb per hr of steam each

Fig. 3 (Right). Old boiler pump was relocated to firing floor, one new pump was added. Grease filter is also shown here

THE OLD BOILER plant of this company, which operates non-ferrous metal rolling mills, is shown in Fig. 1. It consisted of six 78-in. hrt boilers with 18-ft tubes set in one battery and connected with a radial brick stack. Various changes had been made from the original hand-fired flat grates and at the time plans for this change were decided on, three of the boilers were oil fired with rotary cup burners, the furnace floors having been dropped below firing floor level. The other three boilers continued on coal with hand stokers, the coal being brought into the boiler room in the coal dealer's trucks and dumped on the floor, the firemen filling the stoker hoppers by hand.

The boiler plant supplied steam to a large Corliss engine which drove a number of small roll stands by underfloor shafting and gears, steam for heating, and a small amount of steam for process, principally pickling tanks.

The boilers were old, dating from about 1910, and of riveted construction, so that with the forcing possible with the oil burners the circumferential joints had been overheated and rivets began to loosen. The owner's long-range plan contemplated the removal of the Corliss engine and complete electrification of the rolling mills; so rather than install enough new boilers to supply the engine in addition to other plant requirements, and wind up with excessive boiler capacity, it was decided to abandon the engine and install only enough boilers for heating and process work.

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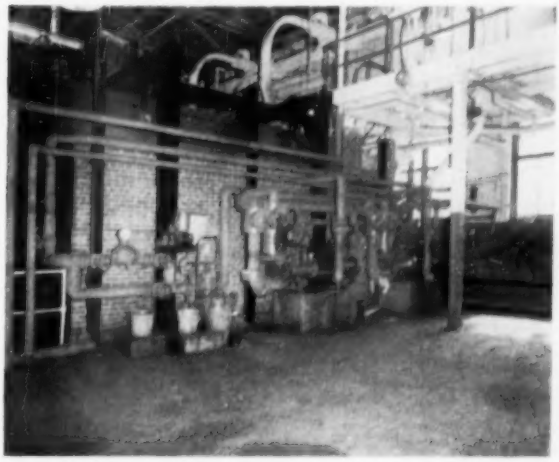


* Consulting Engineer, Westcott and Mapes, Inc., New Haven, Connecticut.

MODERNIZING COST PLANT C – 1951-52

Boilers and settings—three 84-in. dia x 18-ft welded hrt boilers ASME Code for 125-lb pressure, with solid refractory lined settings for oil burning; and removal of four existing boilers	Bigelow Co (Settings by W. C. Meade & Son)	$ 42,947
Demolition of old boilers and foundation work	W. C. Meade & Son	4376
Soot blowers for 3 boilers and piping	Bigelow Co	1482
Disconnecting and reconnecting steam feedwater and blowoff piping, furnishing and installing feedwater regulators	Bigelow Co	4608
Oil-burning installation complete, including steam and oil piping, electric wiring and automatic control	Perfection Grate & Stoker Co	18,141
Equipment: Oil burners	Todd Shipyards Combustion Div	
Forced draft fans	L. J. Wing Mfg Co	
Combustion control	Ace Instrument Co	
Pump and heater set	Perfection Grate & Stoker Co	
Deaerating feedwater heater, tray-type heater, tray-type vent condenser, 40,000-lb per hour capacity, 15-min storage, 30-lb ASME Code	Worthington Corp.	5175
Structural support for feedwater heater	Bigelow Co	2739
Rigging feedwater heater onto support	Bigelow Co	300
Boiler feed pump due 10 x 6 x 10 type V.C. horizontal duplex bronze fitted with cup-type water piston packing	Worthington Corp. through S. A. Rhodes	1128
Vacuum condensate and return	Nash Engineering Co	2651
Pump piping, heater, pumps, etc., and placing pumps	M. J. Daly & Sons	7222
Emergency generator	U. S. Motors Corp. through Connecticut Electric Equipment	3062
Thermal insulation Steam and feedwater piping and feedwater heater	Thermal Insulation Co	1721
Engineering	Westcott & Mapes, Inc	9975
Engineering Expenses		139
Estimated Cost.....$110,000	Actual Cost.....$105,666	
Cost per lb per hr normal steaming capacity.....$2.35		

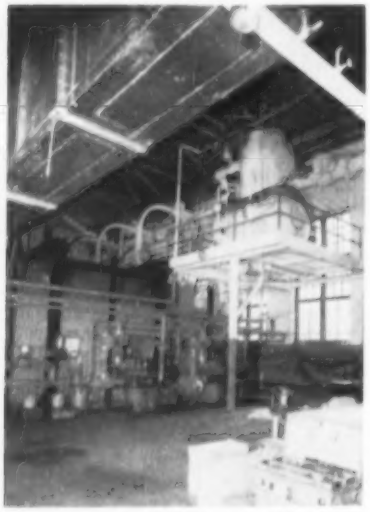


Fig. 4. New feedwater heater was installed while last two old boilers were still in place, hence column support

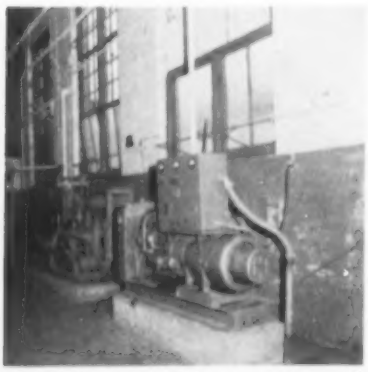


Fig. 5. View of oil burner pump and heater set, also emergency generator

By a rather involved analysis it was determined that the steaming capacity required for the new boilers would be about 30,000 lb per hour, so it was decided to install three 84-in. welded hrt boilers with 3-in. 18-ft tubes to develop 15,000 lb per hour of steam each, one to act as a spare. The new boiler installation is shown in Fig. 2. Oil burners had a little larger capacity.

Maintaining steam for mill operations during rebuilding created a number of problems. Since one of the oil-fired boilers was unusable without extensive repairs and the owner's opinion was that he might wish to keep some of the coal-fired boilers for emergency use in an oil shortage, it was decided to replace the oil-fired boilers.

The alley at the left of the battery was too narrow to provide the additional space for the larger shells of the new boilers, so when the three old oil-fired boilers were removed only two new boilers could be installed in this space. This work was started immediately at the end of the heating season and completed during the summer although it was necessary to use the old feedwater heater and boiler feed pumps from time to time to supply the new boilers.

The old boiler feed pumps were located in a partial basement under the firing aisle and one new pump was purchased to assist in the transfer to the firing floor. The final layout is shown in Fig. 3. This continued use of the old equipment was necessary, for it was not until the fourth old boiler was removed that the location proposed for the feedwater heater, as shown in Fig. 4, was accessible for installing it. The reason for the peculiar location of the column under the heater support was that the heater was installed while the last two old boilers were still in place, though it was ultimately decided to remove them. Once the two new boilers were in service the fourth boiler was removed, the feedwater heater put in place, the third new boiler installed, the new boiler feed pump set up and piped and the better of the two old pumps brought up from the basement to complete the installation.

The old oil-burning installation included a 20,000-gal and a 12,000-gal tank, the latter of which could be filled by gravity from the larger tank, and which acted as a day tank. The old oil suction line from the day tank was adequate for the new capacity, and a pump and heater set shown in Fig. 5 was installed adjacent to where this oil suction line entered the building. Figure 5 also shows the gasoline engine-driven emergency generator. The size of the units and estimates of load requirements warranted the installation of forced draft register-type oil burners with spinning-cup oil atomization. Motor-driven propeller type fans were installed, parts of which can be seen in Fig. 2. Although the owner ultimately decided against the idea, for reasons not connected with its practicability, the oil burner installation was designed for automatic operation with only periodic attendance by a watchman or other employee assigned to that service.

The boiler feed pumps are steam-driven duplex, and the exhaust is used in the feedwater heater after passing through an oil separator. Pressure in the deaerator is maintained by live steam supplied through a reducing valve. The Blackburn grease filter installed in the boiler feed line can be seen to the left of the boiler feed pumps in Fig. 3.

A Nash vacuum and condensate return pump was installed in the former boiler feed pump basement to supplement the existing steam-driven reciprocating unit.

The Centralized Approach . . .

It's all-important to designer, manufacturer, operator of power plant equipment

By C. K. HOOD *

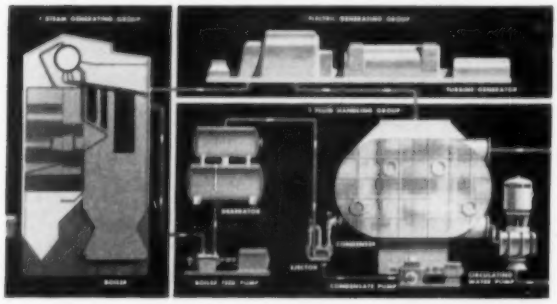


Fig. 1. Three family groups make up the power plant system. Each individual unit depends on all others for efficiency

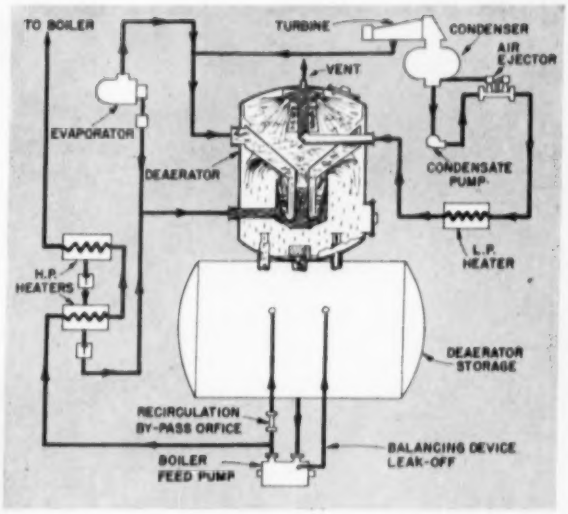


Fig. 2. Deaerator vividly demonstrates the compelling interrelation between one piece of power equipment and others

POWER ENGINEERS often need to stop and remind themselves that the power plant operates as an entire unit, with a number of individual units of equipment all co-ordinated to function as a unified assembly to produce either steam or electricity or both.

The relation between the various units of equipment while they are in operation depends not only on the way they are put together in the system, but on the way they are built in the first place.

Accordingly, "centralized" engineering — the approach that is "system-wise" in its thinking — is a problem for the manufacturer; but it is also something of which the user and operator of the equipment should be very fully aware.

For example, take the deaerator in a central station, to illustrate the compelling interrelation between one piece of power plant equipment and many others, both within and outside of the fluid handling group.

The deaerator receives condensate pumped to it from the main condenser by the condensate pumps. On its way to the deaerator, this condensate passes through the inter- and after-condenser of the ejector and one or more closed heaters. Since the thermal load on the deaerator is dependent upon both the quantity and temperature of the incoming condensate, a thorough understanding of the operational characteristics of this part of the system is essential to proper deaerator design.

Likewise, the deaerator normally receives its steam from an extraction stage of the main turbine at a pressure varying with load. It may also, under certain conditions, receive supplementary steam from a different extraction point. If an evaporator is used in the cycle, the deaerator may receive the entire vapor output of the evaporator and thus serve as an evaporator condenser.

In order to recover maximum heat from the drains for the various high pressure heaters in the feed system without the need for separate drain pumps, it is customary to discharge these drains into the deaerator. Since the quantities are appreciable and the energy release high, very special provisions must be made in the deaerator to accommodate these drains for the heaters.

Last, but far from least, is the relation between the deaerator and boiler feed pumps. The physical location of the deaerator is dictated primarily by the NPSH requirement of the feed pumps. Balancing drum leakoff and recirculation flows must be provided for in the deaerator in a manner that will be fully compatible with the requirements of the boiler feed pump. The proper understanding of transient load conditions under sudden load changes is most important in avoiding suction problems. And, of course, the deaerator must have sufficient capacity to keep the boiler feed pumps supplied with heated and deaerated water under all possible conditions of load.

Aside from the many influences that separately affect boiler feed pump and deaerator operation, these units are always interrelated by: (a) the height of the heater storage tank above pump suction (or the head delivered by deaerator discharge pumps in a low headroom design); (b) head losses in the piping system; (c) the NPSH required by the boiler feed pump; (d) the internal volume of the connecting pipe between tank and pumps.

Now here's a case which shows clearly how system-wise experience paid off quite handsomely in solving a particular customer's problem.

A few years ago, a prominent firm of engineers was designing a power plant and found that boiler feed pump suction difficulties could occur during load surges. Analyzing the problem on the basis of principles developed by Worthington, we found that the time lag in delivering water to the feed pump under load surge conditions was too long. This added up to unsatisfactory conditions at the suction of the feed pump.

You might jump to the conclusion that changing pump or deaerator characteristics was the answer to this problem. Not at all. A thorough knowledge of both units indicated that the pump suction header diameter was the one variable that could and should be changed. By reducing the pipe size from 20 in. to 18 in. and providing for a considerable direct vertical discharge drop out of the deaerator, the water-in-pipe time between the two units was decreased to the point where pressure and temperature decay during all transient loads was within satisfactory limits. This money-saving solution was a result of know-how based on approaching the power plant as a unity.

*Vice-president and manager, Harrison Division Sales, Worthington Corp.

Transductors

By M. J. BROWN

Section Engineering Manager Switchgear Assemblies and Devices Dept. Westinghouse Electric Corp, East Pittsburgh, Pa.

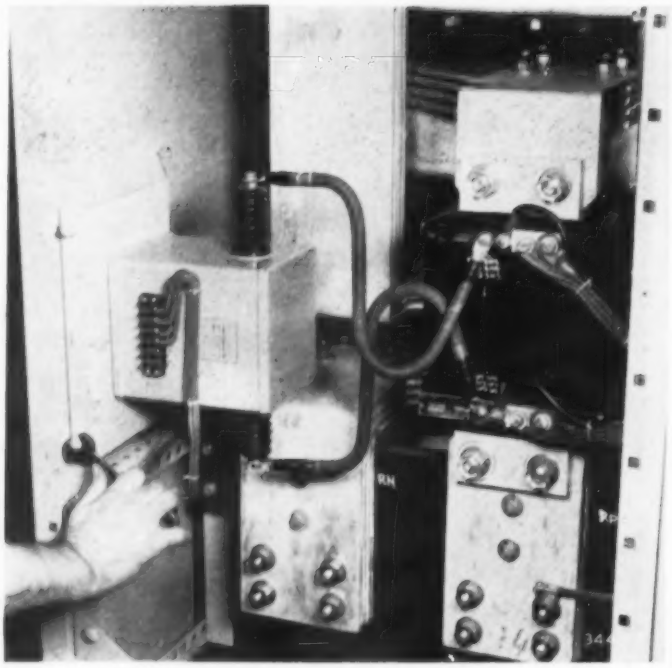


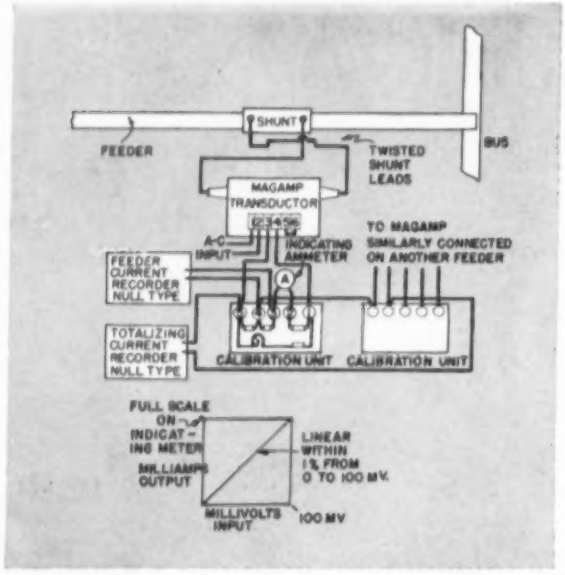
Fig. 1. View in rear of panel showing leads from shunt in high-current d-c bus bar to Magamp Transductor at the left.

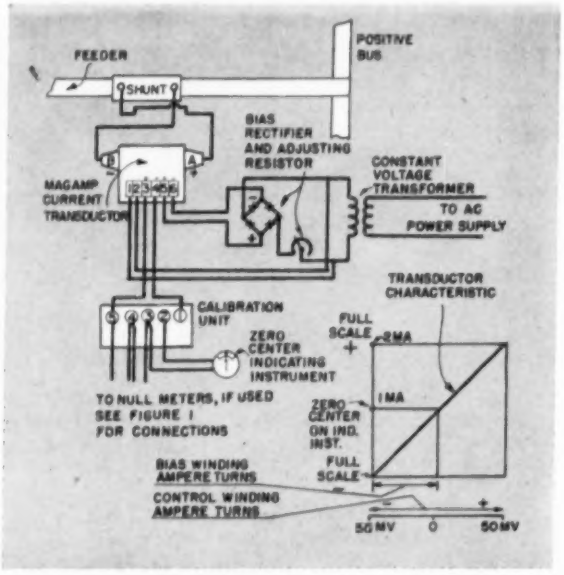
THE MAGAMP MAGNETIC amplifier transductor gives the designer a system whereby d-c milliamperes or millivolts, proportional to the transductor input, can be obtained. Its principal advantage is that electrical isolation of the output can be obtained for the purposes of safety and totalization. There is a further advantage that the leads between the transductor and meter may be of great length as contrasted to the usual requirement that shunt must be limited in length. When used with presently available components, it has a wide range of metering applications. These include metering circuits that totalize current, voltage, watts and watthours on circuit up to 3000 volts d-c.

Experience with magnetic amplifier Magamp transductors has pointed the way to detailed modifications in their design resulting in far reaching changes in their application. Although these devices are still acquiring valuable operating experience, satisfactory field results to date are accumulating into a very acceptable operating history.

Where the earlier transductors consisted of huge iron cores encircling a d-c bus, the modern magnetic amplifier transductor is a small unit that can operate either from a shunt or merely from the drop across a length of bus.[1] Development of

[1] "Direct-current Metering of Large Electrochemical Pot-Lines," M. E. Reagan, AIEE Conference Paper 57-228, January 1957.





Figs. 2 and 3. Two circuits showing connections to Magamp current transductors. Right shows use of zero-center instrument

Solve Tough D-C Metering Problems

means to make the output linear to zero was a significant advance and removed the most troublesome barrier to complete acceptance of the device.

If you were faced with the problem of electrically isolating a system of d-c current metering from a d-c bus, there would be several methods from which to choose. You could use a potentiometric retransmitter, a two-winding current transductor, or the newly developed magnetic amplifier transductor. The method you would select could not be as simple or as direct as the use of instrument transformers on a-c circuits, but the magnetic amplifier transductor does approach these devices in simplicity.

The magnetic amplifier transductor, because of its small size, can be physically located on or in the vicinity of the bus structure. Therefore, the leads which are electrically connected to the bus, or shunt, are not of great length. That is, leads that connect to the bus structure do not extend beyond the transductor. Since the transductor can be located close to the d-c bus, the extension of bus wiring is moderate and easily protected. There is also the advantage that lead resistance is of minor importance when the magnetic amplifier transductor is used.

Isolation in the case of potential metering is similar to that required for current metering. In the past, operating safety has been established by making potential connections through current-limiting fuses or current-limiting resistors. Now that magnetic amplifier transductors are available, full advantage is being taken of the isolation they provide.

The modern magnetic amplifier transductor is possibly one of the most intriguing "black boxes" that one will find in commercial applications. Coming out of this "black box" are two leads to connect to the shunt, two leads for biasing the output, two output leads and two leads for connection to a source of 60-cycle excitation.

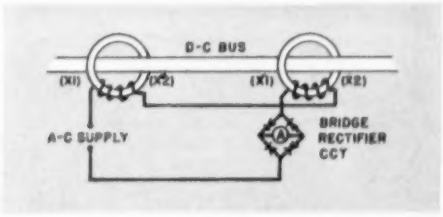
Magamp Current Transductors: Figure 2 shows how this "black box" is connected for current metering and a curve showing how the output varies with input.

Figure 3 shows the same curve with the bias winding energized from a constant current source. The output meter in this case is given a zero center calibration.

Magamp Potential Transductors: The potential transductor is the same basic device as the current transductor. The only difference is that the input circuit is designed for milliamperes instead of amperes. That is, ampere turns for the cores are obtained by many turns carrying low current in the magnetic amplifier potential transductor whereas the magnetic amplifier current transductor uses few turns with high current to obtain the same ampere turns. The potential transductor may be biased to give zero center output and it may be connected into a calibration unit just as the current transductor is. In other words, the excitation, bias and output circuits of the magnetic amplifier potential transductor and the magnetic amplifier current transductor are identical. The input circuits are different. The scales of the indicating and recording instruments are different in that one reads in volts, the other in current but the full scale sensitivity and the type of instrument is the same.

What Is a Transductor?

Editor's Note



There may be some who read this article by Mr. Brown who may not know just what a transductor is; indeed, it is possible they may confuse the term with the more familiar gadget, the transducer. The transducer is a device for converting one form of energy into another. The pick-up on an electric phonograph, for example, is a transducer because it converts the mechanical movement of the needle into an alternating electric current.

A transductor, on the other hand, is a device for controlling one kind of electric current by means of another. In general the term transductor is applied to devices involving magnetic circuits. Another name for the transductor is the saturable reactor in which the magnitude of an alternating current is controlled by varying the degree of magnetic saturation of the core by means of a direct current. Magnetic amplifiers are transductors. In these pieces of equipment the essential characteristic of the magnetic circuit is that the permeability shall be high and nearly constant up to the point of saturation; above this point, if the B-H curve is practically horizontal, any increase in magnetizing force produces practically no change in induction.

Although the uses to which such a characteristic could be put were realized 30 years ago, it is only within the last decade that the principle has been used to any great extent. This is partly because magnetic materials having suitable characteristics (i.e., a sharp cut-off) have only recently become available.

The basic principle of the saturable reactor is based on the fact that the permeability of a core falls off rapidly as the magnetizing field approaches the value corresponding to saturation. Consequently, if one leg of a core is wound with a coil carrying direct current and a second leg is wound with a coil connected through a load resistance to a source of alternating current, the impedance in series with the load can be varied by rather small variations in the direct current in the first winding.

This principle makes possible the direct current transformer used in the schemes described by Mr. Brown in this article. The basic principle of the direct current transformer is shown in the accompanying diagram. This shows a d-c bus passing through two magnetic cores, each carrying a winding. These windings are connected in series opposing with respect to the magnetomotive-force associated with the bus-bar current so that, when the fluxes in one coil are added, those in the second coil are in opposition. The alternating current in these windings is rectified by the bridge circuit of rectifiers and is measured by the direct-current meter. By means of the full-wave rectifier, the current fed to the meter is, in this ideal case, proportional to the direct current in the bus-bar.

This essentially is what goes on in Mr. Brown's *black box*. In Mr. Brown's circuits the direct current fed to the transductor is obtained from the voltage drop across a shunt in the main bus but the principle involved is the same.

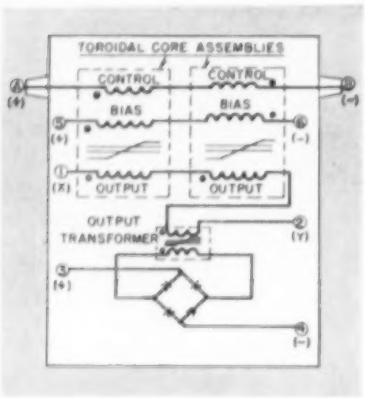


Fig. 4. Internal connections of magnetic amplifier current or potential transductor showing use of bridge rectifier

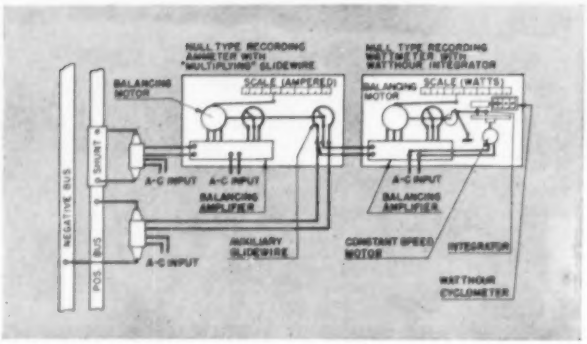


Fig. 5. Watt and watthour metering using Magamp transductors

Detailed Connections: Figure 4 shows the connections inside the magnetic amplifier current or potential transductor. Note particularly that there is electrical isolation in each branch of the circuit. The isolation of the input gives the much-desired protection against fault exposure of the main d-c bus. The excitation winding is isolated from the input and the output circuit permitting one unit to be connected to another for totalizing purposes, even though they are connected to common sources of excitation and bias. The output transformer has special characteristics which make the output linear in the region close to zero. At the same time, it provides electrical isolation of the meters from the a-c input source, a feature to be desired in the interest of safety.

The Calibration Unit: A calibration unit has been devised which makes the calibration of output instruments simple and flexible. Referring again to the curve in Figure 3, it should be added that manufacturing variations will cause each individual transductor to have an output that is within ± .5 milliamperes of the nominal value of 3.5 milliamperes. So, if we wish to use a meter which reads full scale at full input to the transductor, we must bypass some of the output current — more for a transductor with a high individual output and less for a transductor with a low individual output. This is exactly what the calibration unit does. There are two parallel paths through it, (see Fig. 1), one which carries meter current, the other which carries the unused excess. To extend the scope of the equipment, each calibrating unit is equipped with two precision resistors. The drop across one of these can be applied to a null type potentiometric instrument if recording is desired, while at the same time the drop across the other resistor may be connected in series with similar resistors in other transductor circuits to obtain totalizing.

Watt and Watt-Hour Metering: Can the Magamp transductor be used for watt-hour metering? With the proper auxiliary equipment, it can provide this service. In Fig. 5, a potential transductor supplies potential across the body of a slide wire. The position of the moving contact on the slide wire is determined by a potentiometer type recorder, which moves to a position proportional to the output of the current transductor. The potentiometer output is therefore a product of current and voltage. This is delivered to a null type indicating meter equipped with an integrator. The indication will be watts, the integration watthours.

Turbine Spindle For Shippingport

Photograph at the right, taken at the Lester, Penna. plant of Westinghouse Electric Corp, shows the steam turbine spindle for the Shippingport Nuclear power plant being readied for shipment to the site. It has already been delivered. When assembled, the 100,000-kw turbine will measure nearly 81 ft in length. The unit will be capable of handling 1,400,000 lb of steam per hr. To date, this is the largest steam turbine to be installed in any nuclear power station.

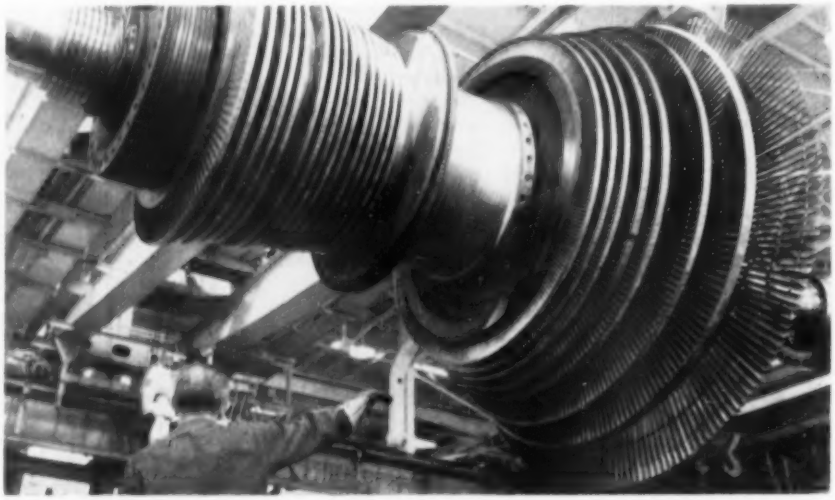


Fig. 1. The secret is extra heavy black pipe, 1-in. in diameter, which runs parallel to conveyor along wall of conveyor tunnel. Pipe carries grease under pressure for lubrication of conveyor

Fig. 2. Now one man instead of two services conveyor. He uses a 20-ft hose that fastens to heavy-duty valves spaced about 40 ft along piping. Ordinary gun services fittings

Fig. 3 (left). A 40-to-1 ratio, air-powered pump is set on top of a 54-gal drum of grease, to pump lubricant into piping. Up to 8000 psi greasing pressure is supplied depending on air pressure applied to the system's air pump

Fig. 4. A booster is installed in the piping near the end farthest from the pump. This is a fabricated air container, 1½- by 20-in., that provides a kick for gun when shut-off valve is opened

Compressed Air Cuts Lubrication Costs On Coal Conveyors

GREASE CAN BE supplied at four cents per lb savings or more, and a two-man greasing team can be cut to one man — utilizing piped grease and compressed air power along a coal-handling conveyor belt in a utility plant.

This is the experience reported by Wallace E. Saxton, in charge of the modern electric plant of Jamestown, N. Y., where such a lubrication system has been operating since the winter of 1954. The photographs above show the Jamestown method.

Hundreds of feet of coal-handling conveyor (Jervis Webb) move coal from the plant yard to overhead bunkers in two parts of the plant. Formerly two men periodically patrolled the tunnel housing this conveyor equipment, one carrying a 35-lb pail of grease, and the other operating a grease gun at hundreds of fittings at pulleys, idlers and other conveyor parts.

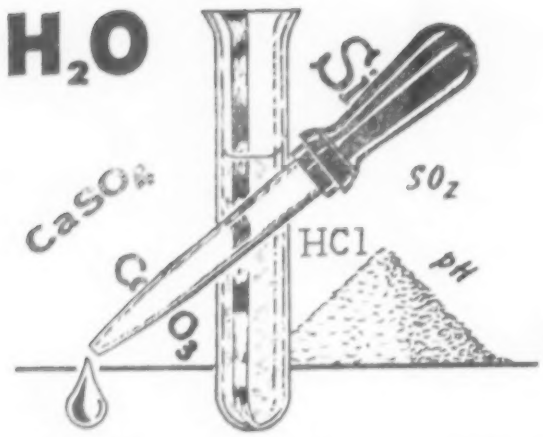
Now grease is supplied under pressure from an air pump, through some 470 ft of extra heavy black pipe, and one man does the lubrication job.

The system includes two shut-off valves that enable the lubricator to segregate sections of the piping or greasing system. After some trials, a booster (Fig. 4) was found effective when installed in the piping near the end farthest from the system's air pump.

The Jamestown installation was done by utility maintenance men, working from a design suggested by lubrication (Alemite) engineers.

Some difficulty at fittings and valves was experienced when steel chips from installation work got into the grease line — a factor which should be taken into account in planning installations of this kind.

Also, the grease used at first at Jamestown proved to be too heavy for cold weather, and had to be changed to facilitate piping.



Want to improve efficiency? . . Reduce downtime? . . Save money? You can, but first . .

Treat Your Cooling Water Right

By R. G. DALBKE*
and
J. M. MASTERSON*

SUCH PROBLEMS AS scale formation, corrosion, biological growths, and wood deterioration are often encountered in the operation of cooling water systems; these problems, however, can be controlled or eliminated by proper water treatment. It is the purpose of this article to discuss the nature of the problems and point out treatment methods that have proven effective.

Scale Formation

Scale or deposit formation can occur in all types of cooling systems. Deposits may be caused by the precipitation of calcium and magnesium hardness in the water, by the oxidation of dissolved iron, by the accumulation of suspended matter, such as mud, sand, silica, oil, wood, etc., and by the presence of biological growths. In any case, the deposits are undesirable since they impede heat transfer and reduce the effectiveness of the cooling system. Failure of the cooling water to perform its desired function can result in increased operating costs or possible damage to expensive equipment.

In the case of an air conditioning system, the result would be the inability of the unit to perform in accordance with its design capacity. It is estimated that a scale thickness of only 0.006 in. will reduce the heat transfer by 30 per cent in a system utilizing a water-cooled Freon condenser.

Once Through Systems. For once through systems, cost is generally too great to permit installation of any elaborate treatment method. However, in waters exhibiting scale forming tendencies, polyphosphates are often used since they possess the property of preventing precipitation of hardness, at least until the water has passed through the system. A polyphosphate residual of 1 to 3 ppm is generally effective in such systems. Polyphosphates also help reduce the possibility of iron deposits since dissolved iron will also be kept in solution under average conditions.

Whether or not a water is scale forming depends upon the relationship of calcium hardness, total alkalinity, pH, temperature, and other minerals present. The Langelier Index correlates these variables and an arbitrary value is given to the result which measures the tendency of the water. A positive value shows scale forming properties; a negative value demonstrates corrosive tendencies. Sequestration of hardness by the polyphosphate method is normally effective in waters possessing a Langelier Index below + 1.0.

Closed Recirculating Systems. In closed recirculating systems, scale can be prevented by using a low hardness, good quality water. Since make-up is generally negligible for these systems, the introduction of scale-forming minerals is kept at a minimum and scale formation does not represent as great an operating difficulty as does corrosive attack. The proper method of preventing this corrosion will be dealt with subsequently.

Open Recirculating Systems. Potentiality of scale formation in open recirculating systems is dependent upon the nature of the water used and upon operating conditions, particularly with reference to the water temperatures involved. Since calcium and magnesium compounds found in most raw water supplies decrease in solubility as the temperature is increased, the scale forming tendency (the Langelier Index) of the raw water is increased when it is used for cooling.

Carbonate scale: The least soluble of calcium and magnesium salts found in raw water is calcium carbonate, which constitutes the most common type of water-formed deposit. Usual external treatment methods of preventing calcium carbonate deposits involve reducing the calcium carbonate content of the water either by zeolite softening, sulfuric acid feed, or treatment with cold lime followed by sulfuric acid feed. In the use of a zeolite softener, calcium and magnesium compounds are replaced by highly soluble sodium compounds, while with sulfuric acid feed, calcium carbonate is converted to the more soluble calcium sulfate. The cold lime-acid method first removes a portion of the calcium carbonates by precipitation and then converts a remaining portion to the sulfate.

Sulfate scale: In converting calcium carbonate to calcium sulfate it must be remembered that sulfate also has its limitation in solubility. Calcium sulfate scale will occur in recirculating systems where the concentration of the compound is permitted to become excessive. Consequently, it is necessary to deconcentrate the system by removing a portion of the cooling water either continually or intermittently. It is generally recommended that a small bleed-off valve be installed on the recirculating line to provide for continued deconcentration while the system is in operation. Frequently, the amount of water lost by windage in cooling towers or spray ponds removes enough cooling water so that additional deconcentration is unnecessary.

With waters containing a high amount of sulfate ion, other than that present as calcium sulfate, solubility is further decreased in accordance with the solubility product relationship.

Acid feed: A simple method of feeding sulfuric acid involves the use of an eductor-type dispenser (Figs. 1 and 3) which allows for removal of

* Technical Sales Service Dept., Dearborn Chemical Co.

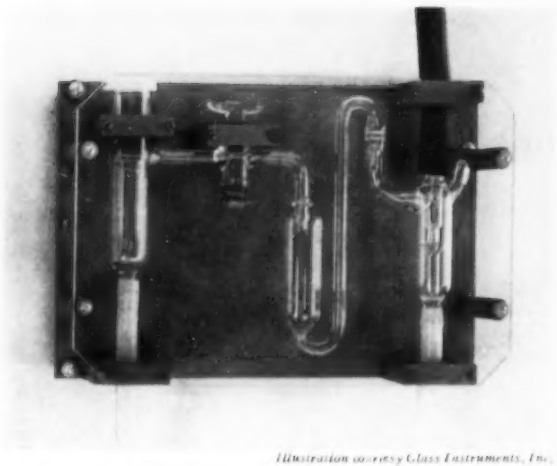


Illustration courtesy Glass Instruments, Inc.

Fig. 1. Liquid dispenser for feeding acid to cooling water system. Feed can be adjusted from 1 to 200 gallons per day

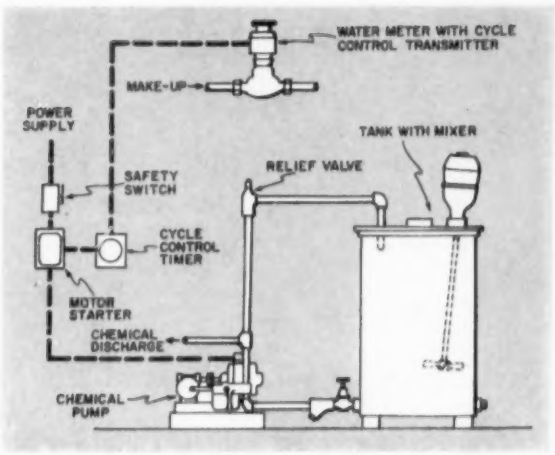


Fig. 2. A typical cycle-control treating plant for chemical feed in larger systems; these are applicable to slug feeding

the concentrated acid directly from the carboy. This unit eliminates the need for an expensive acid storage tank, or special acid handling equipment. The dispenser is particularly adaptable to small systems since the acid feed can be regulated down to an extremely minute rate.

Silica scale: Under certain conditions, silica-type scale is formed due to the high amount of silica in the cooling water. Consequently, the deconcentration rate is then based upon the silica in the recirculating water rather than upon the calcium, sulfate, or other minerals. Maximum silica residual of 200 ppm as SiO_2 is recommended in order to avoid formation of this type of deposit. Contamination of the cooling water with sand or silica-bearing dust can also contribute to this problem. Cold lime treatment may be used to reduce the silica content of the water supply and thereby reduce the rate of deconcentration.

Zeolite softening: This is an effective method of preventing scale which is due to relatively high hardness in the raw water supply but it is not practical for all systems. For large plants, the cost of obtaining a softener of suitable capacity would be excessive, particularly since the zeolite method does not eliminate the necessity of acid feed to produce the desired pH range. With acid feeding, the scale-forming tendencies of most waters can be brought under control and external softening is not generally required.

In smaller systems, especially in the absence of wooden structures, the zeolite method is highly suitable. Methods of corrosion prevention will still be required, however.

Other deposits: Mud, silt, oil, and other contaminants are frequently present in surface waters. The removal of these materials is effected by coagulation, settling, and/or filtration. In some cases settling alone will produce a satisfactory water, or coagulation and settling can be used without filtration if a slight amount of turbidity is not sufficient to cause operating difficulties.

System Cleaning

Cooling water systems which have been operated without water conditioning, or with improper methods of treatment, very often build up considerable accumulations of deposits. It is good practice to clean the system thoroughly and then initiate an adequate water treatment program designed to prevent re-occurrence of the deposit formation.

Types of deposits most frequently found in the cooling systems, for the most part, readily lend themselves to rapid removal by an acid cleaner. It is extremely important that this material should contain effective inhibitors to protect the metallic portions of the system against possible chemical attack during the cleaning process. Because of this, ordinary technical grade acids should not be used; a suitable acid cleaner should be obtained from a reputable firm specializing in such materials.

To determine if the acid will do a complete job it might be necessary to have a sample of the deposit analyzed to determine its chemical composition and the best type of cleaner to use.

Generally, inhibited muriatic acid or sulfamic acid provide the best agents for the removal of most water-formed deposits. For the larger systems, economics would normally dictate using muriatic acid; for small systems, inhibited sulfamic acid possesses many distinct advantages and is most frequently applied. Sulfamic acid is a powdered material obtained in ordinary fibre drums, eliminating the handling of carboys or other special containers. Storage of dry sulfamic acid is quite safe.

Cleaning is accomplished by means of a 3 to 8 per cent solution of the acid in water. In a badly scaled system, more than one cleaning might be necessary. Approximately one lb of $CaCO_3$ scale would be removed by two lb of sulfamic acid. As a direct comparison, 2.4 lb of 30 per cent muriatic acid would be required to dissolve one lb of $CaCO_3$. A sulfamic acid cleaner costs approximately three to four times as much per pound as does a muriatic acid cleaner, resulting in a substantially higher cost for the cleaning operation.

It is also possible to slowly remove scale by careful control of the sulfamic acid feed during the operation of a cooling tower system. However, this method presents many difficulties with regard to maintaining the desired chemical balances, particularly if large amounts of scale are being removed. It is preferable to shut the system down and clean it thoroughly if this is at all feasible.

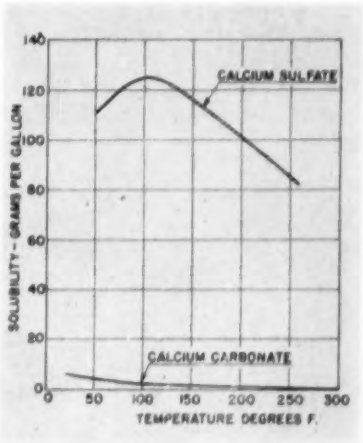


Fig. 3. Solubility of calcium sulphate and carbonate at various temperatures

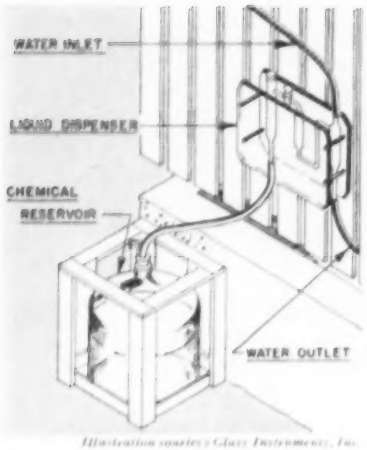


Illustration courtesy Glass Instruments, Inc.

Fig. 4. Diagram of the dispenser shown in Fig. 1. Mount above carboy, outlet

The alternative should be kept in mind, however, if a system is scaled up and the plant can not be readily shut down. Maintaining a pH of 6.0 in the recirculating water, using adequate corrosion inhibitors, and deconcentrating the system to remove the loosened and dissolved scale are necessary to insure success using this method of cleaning.

Deposits will sometimes form on wooden portions of cooling towers that undergo alternate wetting and drying. These deposits can normally be removed by washing the structure with a high-pressure water stream. Usually the deposits are composed of water-soluble materials which have accumulated due to the evaporation of the cooling water. Heavy rainfall will remove water-soluble substances, but occasional washing may be required in some areas to keep the tower scale-free.

Periodic cleaning of the tower basin is also recommended as a means of removing sand, mud, wood, and other debris which accumulates over prolonged periods of operation. This type of cleaning is accomplished, however, without using any special cleaning material and merely requires a washing, flushing, and draining operation.

Corrosion and Its Control

There are many waters in the United States which are corrosive to metals, especially those of the ferrous type. Also, acids are often used to control deposits with scale forming waters and, while no trouble with deposition is encountered using this procedure, corrosion then becomes a problem.

When recommending a method to control corrosion, it is necessary to consider the type of cooling system since the means of control in one system may not be applicable to another. For instance, the usual method of treatment for a closed system can not, for economic reasons, be utilized in connection with open systems.

Other factors to consider when selecting a specific inhibitor include local regulations on the discharge of treated water into streams and the possibility of contaminating buildings in the area around towers or spray ponds due to wind losses.

Most common cause of corrosion in cooling water systems is dissolved oxygen. This is particularly true for open systems incorporating cooling towers. These units are similar to air washers and the intimate mixing of water with air usually results in the cooled water becoming saturated with oxygen. In addition, other corrosive gases such as sulfur dioxide and hydrogen sulfide may contaminate the recirculating water in industrial areas. Sometimes this contamination may be severe enough to require the application of an alkali to prevent a serious reduction in pH.

Corrosion can also be caused or influenced by other factors, including galvanic action, biological growths, suspended solids in the water, and improper design of the system. In addition, relatively high concentrations of chlorides and sulfates will have a deleterious effect on metals.

Closed systems: Systems which are designed to recirculate cooling water with essentially no water losses are commonly referred to as the closed type. They are often installed for use in connection with compressors, diesel engines, chilled water for air conditioning, etc. Normally, the water is cooled through heat exhangers which use water from open systems.

Chromate Treatment Effective

As there are small amounts of losses, closed cooling systems can usually be treated with high concentrations of corrosion inhibitors. Chromate type treatments are most commonly applied since for many years, chromates have been the most effective. For the average closed system, the maintenance of 800 to 1500 ppm chromate in the cooling water is normally sufficient to prevent metal attack. However, with diesel engines employing relatively high recirculation rates, it usually is necessary to maintain chromates in the order of 2000 to 3500 ppm and in some cases up to approximately 5000 ppm.

In recent years, due to some objections to chromate toxicities, other type of inhibitors have been developed. In many instances the non-chromate treatments have been successful in controlling aggression of metal components. Most of these inhibitors incorporate borates and nitrites with effective concentrations running in the range of ½ to 1 oz per gal. of water in the system.

Once-through systems: Due to the relatively large amounts of water used for cooling purposes, the type of treatment employed is limited by economic considerations. Fortunately, however, corrosion is not too often a serious problem because there are no corrosive gases absorbed by cooling towers, and minerals which might be aggressive to metals are not concentrated.

The inhibitors most often applied include sodium polyphosphates, dimetallic polyphosphates, tannins, silicates, and combinations of these. In most instances, dosages in the order of 2 to 10 ppm are applied, but in some cases, considerably higher feed rates may be necessary. For optimum results, the chemicals should be applied continuously or semi-continuously, preferably through the use of automatic feeding equipment. However, in many plants, chemical treatments in the form of briquettes are applied through the use of by-pass feeders with apparent success.

Inhibition of corrosion depends on the formation of a protective film on the metal surfaces but the treatment used must not cause this film to build on itself and interfere with heat transfer. Some operators use the "controlled scale" principle to prevent metal attack, but this is comparatively difficult to regulate. The method, in theory, depends on the formation of an eggshell-type scale which protects surfaces beneath it.

Alkali May Form Scale

For a corrosive-type water having a negative Langelier Index, an alkali such as soda ash or lime could be fed to precipitate a deposit in the system. However, often undesirable results are obtained due to temperature variations in the system — a thin scale is formed in cooler sections while, on the hotter surfaces, the resultant deposit is too thick and interferes with cooling efficiencies.

Open recirculating systems: Treatment methods depending on the use of straight chromates are often economically feasible for relatively small recirculating systems employing cooling towers and spray ponds. For these systems, the maintenance of cooling water chromate concentrations in the order of 300 to 500 ppm usually is sufficient to control corrosion. Sometimes, when initiating a treating program, high concentrations of chromates, in the order of 500 to 1000 ppm, are maintained for a short period of time to form a protective film rapidly. For the average plant, pH control is not critical with this procedure, but it is good practice to limit the pH to a maximum of 7.5 where wood towers are installed.

It must be pointed out that chromates can not be applied universally because of their toxic nature to fish and animal life. Many local regulations prohibit the discharge of blowdown water containing chromates into natural bodies of water. For this reason the regulations governing stream pollution should be checked before chromate treatments are applied.

Another possible objection to the utilization of chromates might be staining of structures in close vicinity to the cooling tower or spray pond because of drift losses.

In recent years, a system was de-

veloped whereby a combination of chromates and polyphosphates are used for corrosion inhibition. The primary advantage of this system is that better protection against pitting-type corrosion is obtained than by using either chromate or polyphosphate at the same total dosage. The average concentration of chromate and polyphosphate maintained in the cooling water is approximately 60 ppm. However, good results can be obtained in many instances with lower dosages. The controlling factors include skin temperatures in heat exchange equipment and concentration of corrosive salts and gases in cooling water.

The question may be asked, "What ratio of chromate to polyphosphate should be maintained?" Based on laboratory studies and field experience, essentially equivalent results are obtained at chromate-to-polyphosphate ratios of 3:1, 2:1, 1:1, 1:2 and 1:3. Often 2 or 3 parts of chromate to one part of polyphosphate is preferred since the lower concentration of polyphosphate reduces the tendency to form calcium phosphate type deposits in the system. One convenient way to control corrosion in relatively small systems is to apply briquettes containing the proper ratio of chromate to polyphosphate. With the use of chromate-polyphosphate treatments, pH control is very important. For the most effectiveness, the cooling water pH should be maintained in the range of 6.0–7.0.

Zinc Salts Used

Sometimes chromate-polyphosphate inhibitors are supplemented by the use of zinc salts. The addition of zinc, in many instances, apparently can cause the protective film to form quicker. Also, excellent results can often be obtained at lower dosages of chromates and polyphosphates when zinc is used.

If circumstances prevent the use of chromates, then a polyphosphate type inhibitor would probably be recommended.

While in general, essentially straight polyphosphates are not as effective corrosion inhibitors as straight chromates or combination chromate-polyphosphate treatments, they do, in many instances control attack of metals in the cooling water system. The dosage recommended varies with the severity of conditions. For cooling equipment operating at relatively low temperatures, polyphosphate concentrations in the order of 10 to 20 ppm may be sufficient. In the treatment of most air conditioning systems, polyphosphates kept in this range are usually adequate. With higher temperatures, it may be necessary to maintain 60 to 80 ppm of treatment.

In recent years, dimetallic polyphosphates have been employed for control of corrosion with appreciable success. The products contain metals such as zinc or manganese and one major advantage is the rapid laying-down of the protective film.

Other chemicals sometimes used to control corrosion include silicates and tannins, or combinations of these with polyphosphates.

Biological Growths

Presence of biological growths in a cooling water system are often very undesirable. Organisms in the form of algae and bacteria can directly result in efficiency loss in heat exchangers and cooling towers and also may contribute to deposit formation and corrosion. Certain organisms may act as binders in combination with other constituents in the water and lead to the build-up of deposits on cooling system surfaces. Biological growths may be responsible for corrosion due to attachment to metals with subsequent screening of the surfaces from contact with free-flowing inhibited water.

There are a number of chemicals used for controlling the growth of organisms in cooling water systems. The choice of specific biocides will depend on factors such as type of growth present, characteristics of minerals in make-up water, local regulations governing chemicals present in blowdown water, etc.

Chlorine is the most common biocide used. For the relatively small systems where chlorine is desired, it is usually more practical to feed water solutions than straight chlorine. Hypochlorites are commonly used where chlorine treatment is preferred for preventing biological growth in small systems. A chlorine residual of 0.5 to 1 ppm is sufficient in many instances to control biological build-up.

Recently rosin amine type biocides were developed and normally these agents are quite effective in low dosages for controlling algae. In most cases, less than 5 ppm maintained in the water for short periods of time is sufficient. Rosin amines have a major advantage over many other biocides because the usual concentrations of chemical applied are not toxic to fish and animal life. Rosin amines are available in liquid form and can be applied to small systems through the use of gravity feeders.

Phenolic compounds are often used for control of micro-organisms. Sodium pentachlorophenate, one of the phenolics, is frequently applied both to large and small cooling systems. This chemical is available in the form of small briquettes which weigh approximately one ounce each. The treatment may be simply introduced by placing the briquettes in a cloth bag which is suspended in the system water at a point where gradual solution results.

Sodium pentachorophenate dosages required will vary with the specific types of organisms present, but in most cases the concentration for good control will be in the order of 40 to 200 ppm based on the capacity of the water system. The concentration

Fig. 5. A cooling water treatment comparator for checking both chromate, pH

should be maintained for a sufficient length of time to kill the growths present.

There are numerous other chemicals used for biological control. These include copper salts, quaterneraries and bromides. In some cases it is necessary to use combinations of two or three different agents for effectiveness.

Control of Wood Deterioration

There are three main types of cooling tower wood deterioration: these include erosion, fungus attack, and deliquification.

Erosion usually is the result of suspended matter present in the recirculating water and may be controlled by removal of insoluble material from the make-up or system water. If the installation of filters or settling tanks is not practical, then the amount of suspended material must be controlled by blowdown. Sometimes dust contamination from the surrounding area of the cooling tower can lead to erosion difficulties.

Decay of wood due to fungus attack is sometimes a rather serious problem. It is usually difficult to control by chemical treatment of the water, and where this is encountered, the wood is normally treated. This requires that the tower be taken out of service. There are a number of wood treating procedures and the experts are not entirely in agreement as to which process is most effective. However, at present the Double Diffusion method which consists in alternately spraying the wood with copper sulfate and sodium chromate solutions seems to be the most satisfactory. Other chemicals such as creosote, zinc sulfate and phenolic derivatives are sometimes used. Some cooling tower manufacturers are treating the wood prior to installation and for this purpose, the Erdalith process is used. This consists in cooking the wood under pressure in a solution of copper sulfate, potassium dichromate, and arsenious acid.

Philo Set

Philo Station Establishes Record of Economy

COMPLETION OF THE new power station at Philo, O., adds another link to the great system of 1,250,000 kw. generating capacity which is under control of the American Gas & Electric Co. Specifically, this station is operated as a base load plant by the Ohio Power Co. and as such it is interconnected with a vast distribution system which includes lines extending from Wheeling, W. Va., South Bend, Ind., Toledo and Cleveland, O., and Pittsburgh, Pa.

Economy to be expected from a station is primarily based upon the design. The use at Philo of high steam

Fig. 1. Excerpts from 8-page article on original installation of two 40,000-kw reheat units at Philo Plant, published in June 1, 1925 issue of *Power Plant Engineering*, now POWER ENGINEERING. Right insert-Portion of page from article showing two original reheat turbine generators at Philo in 1925. They were very advanced design for their time. One of these has been replaced by the new supercritical Unit No. 6, Fig. 6

OPERATING RESULTS AT PHILO STATION

	Week Ending - April 11	April 1
Plant thermal efficiency	23.86	24.90
B.t.u. per kw.hr. output	14318	13715
Lb. coal per kw.hr. generated	1.25	1.28
Lb. coal per kw.hr. output	1.32	1.32
Total kw.hr. generated	5,581,000	5,318,000
Total kw.hr. output	5,276,000	5,080,130
Total kw.hr. auxiliary power	225,600	217,230
Per cent auxiliary power	4.01	4.09
Total coal consumed - lb.	6,962,000	6,624,000
Total water to boilers - lb.	50,525,600	49,559,000
Total treated water used - lb.	1,741,000	1,641,080
Aver. plant water rate per kw.hr. output	9.58	9.67
Aver. plant water rate per kw.hr. generated	8.05	8.36
Aver. condenser pres., in. ab.	0.84	0.92
Aver. temp. circulating water, inlet	51	57
Aver. temp. circulating water, outlet	58	65
B.t.u. per lb. coal as fired	10,945	10,390
Per cent moisture in coal	6.49	10.28
Per cent ash in coal	14.74	16.67
Per cent combustible in ash	7.34	6.54
Per cent coal lost in ash	1.52	1.60
B.t.u. per lb. of coal lost in ash	165	166
Aver. steam pres., lb. gs.	525	534
Aver. steam temp. deg. F.	706	704
Aver. temp. feed water to economizer	189	193
Aver. temp. feed water to boilers	308	313
Aver. temp. flue gas, boiler outlet	569	591
Aver. temp. flue gas, stack, unit #1	353	361
Aver. temp. flue gas, stack, unit #2	-	354
Aver. temp. flue gas, economizer outlet	353	356
Aver. actual evap. per lb. coal	7.86	7.48
Aver. evap. from and at 212 deg. F.	8.97	9.80
Aver. factor of evap.	1.234	1.230
Aver. per cent boiler rating	231.66	221.42
Aver. per cent eff. boiler, furnace & economizer	90.26	85.93
Aver. plant load factor	69.78	61.09
Aver. generated load per turbine service hr.	33280	29186

Fig. 2. Table of operating results, Philo Plant Units 1 and 2, for two typical weeks in the early part of 1925, showing all the operating data. This table was included in the article shown above

Fig. 3. Philip Sporn as he appeared in 1925 when he was an electrical engineer with American Gas & Electric

With M. L. Sindeband, electrical engineer, E. A. Johnson, mechanical engineer, and associates, they worked out design of record-setting Philo Plant in close coöperation with Sargent & Lundy, consulting engineers, and with the manufacturers of the equipment that set performance record

Records in 1925 . . . Does It Again in 1957

By CHESTER R. EARLE
Executive Editor
POWER ENGINEERING

New supercritical Unit No. 6 now in service at Philo Plant of Ohio Power Co (AG&E); capacity 125,000 kw; operates at 4500 psi, 1150 F, with double reheat; heat rate 8530 Btu per kwh. Compare this with 40,000-kw Unit No. 1 of 1925, which Unit No. 6 replaces, which operated at 600 psi, 725 F, which had heat rate of 13,715 Btu per kwh, and was one of first to incorporate reheat and other very advanced power plant construction features of that time

ONE OF THE most interesting experiences an editor in the power field can have is to inspect a new modern unit installed in a record-breaking plant that he may have described 25 or 30 years before in his magazine. But it is of the highest interest and importance to him when that modern unit is the first to break through into a new era in steam-electric power production and set new records.

That was exactly the experience this writer had on May 7, when he attended the press preview of the country's first supercritical Unit No. 6, now in operation at the Philo Plant of Ohio Power Co, important component of the American Gas and Electric Co's far-flung system, and located 9 miles down the Muskingum River from Zanesville, Ohio. For it was in 1925 that this writer visited the Philo Plant to see the original installation of two turbine-generator units that were among the largest then installed, incorporating features that were then much ahead of their time, enabling the plant to set new records for economy in that period.

In contrast, on May 7, 1957, this writer saw how the original Unit No. 1, a 40,000-kw machine, had been replaced in practically the same space by the new 125,000-kw, 4500-psi Unit No. 6 shown here. This was a most impressive demonstration of the technical progress made in the field in 32 years. But it is even more important than that in pointing the way to still further economies in capital investment, reductions in cost of generation, and development to keep pace with the ever-expanding needs of the country for power.

The original No. 1 Unit (and its No. 2 companion) at Philo was described in an 8-page article, Fig. 1, in the June 1, 1925 issue of *Power Plant Engineering*, now POWER ENGINEERING. The article gave a complete list of equipment and details of the outstanding features.

For example, as explained in much detail, the plant had very large steam turbines employing reheat and operating at what were then very high

Fig. 5. Exterior view of Ohio Power Co's Philo Plant as it appeared May 7, 1957

Fig. 4. Philip Sporn as he appeared at Philo Plant on May 7, 1957, interviewed by Executive Editor Earle

He is now president of American Gas & Electric Service Corp, the engineering organization for the entire AG&E System. Again in close coöperation with the equipment manufacturers, the Service Corporation designed new supercritical Unit No. 6, a worthy heir to the station's operating tradition

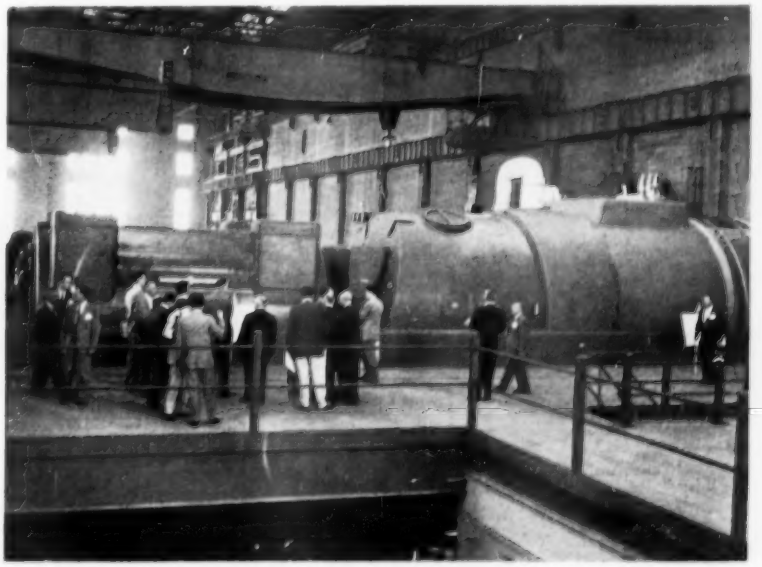


Fig. 6. A general view of the new 125,000-kw supercritical Unit No. 6 at Philo

Fig. 7. Portion of Unit No. 6 centralized control room, showing operator inspecting a few strip chart recorders

Fig. 8. Philo plant always had its own completely equipped machine shop, over which control room is now located

Fig. 9. Stanley Rudge of Ohio Power shows model of Philo's 4500-psi steam generator to Executive Editor Earle

Fig. 10. Diagram of full-load heat cycle for Philo's new supercritical Unit No. 6

steam conditions of 600 psi, 725 F; stoker-fired boilers equipped with air preheaters (very new then) as well as with economizers; separate reheat boiler; coal storage under water; circulating water supply by gravity flow 10 months of the year; central control room; vertical condensers, and other advanced features.

The original station in 1925 operated at a heat rate of 13,715 Btu per kwh output, corresponding to a thermal efficiency of 23 per cent. Today, the new Unit No. 6 operates at a heat rate of 8530 Btu per kwh at full load, or a thermal efficiency of 40 per cent, illustrating the progress in the art made in the relatively short span of 32 years.

No attempt will be made here to describe the new Unit No. 6 in detail, for this has already been done in several papers presented before the American Society of Mechanical Engineers. One on the general design is by S. N. Fiala, Chief Engineer AG&E Service Corp, Paper No. 55-A-137. Another is on the supercritical steam generator, by J. D. Andrew of the Babcock & Wilcox Co, Paper No. 56-5-12. A third is on the supercritical turbine generator by Elston and Sheppard of General Electric Co, Paper No. 55-A-159.

Unit No. 6 and its steam generator were installed in the space formerly occupied by Unit No. 1 and its three standard boilers and one reheat boiler. It uses a double reheat cycle, Fig. 10, for the first time in the history of the art. It is a single-shaft machine, with high-pressure turbine, reheat turbine and low-pressure turbine all mounted on one shaft. The steam generator, Fig. 11, is not a boiler, for in generating steam at 4500 psi, 1100 F, there is *Continued on page 96*

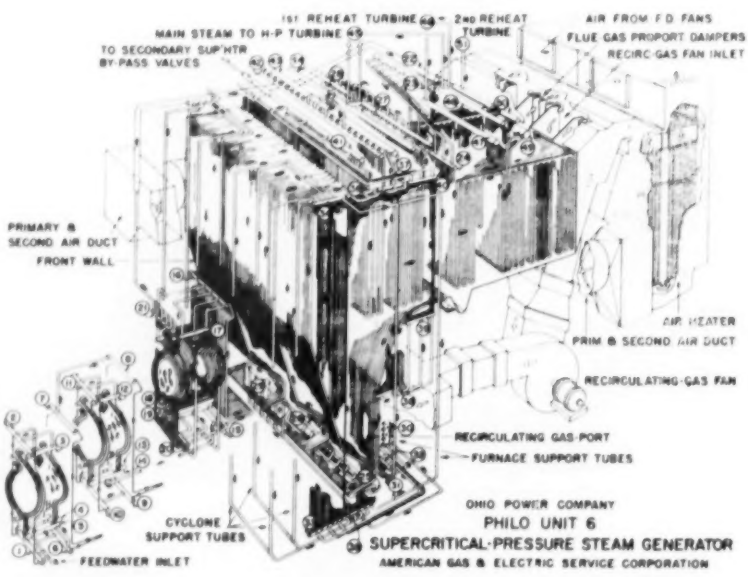
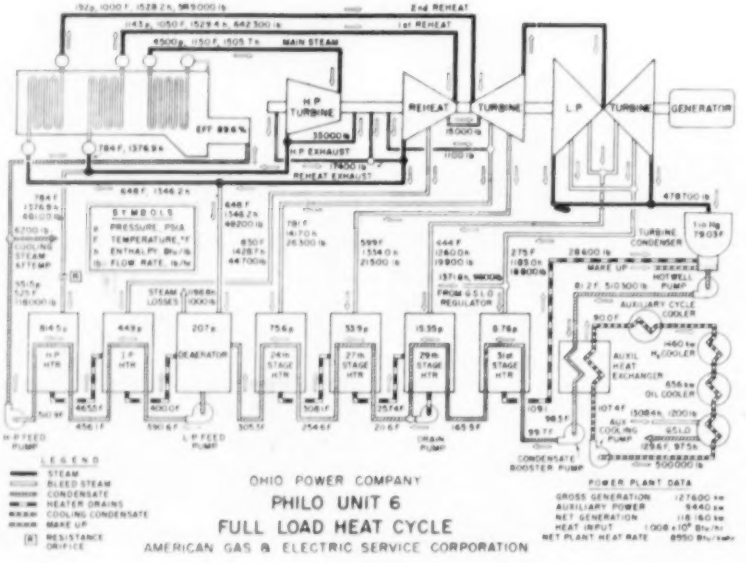


Fig. 11. Perspective drawing of supercritical steam generator for Philo No. 6



What Does Thermal Efficiency Mean In Nuclear Power?

ONE REASON for the comparative lack of enthusiasm in nuclear power systems among power engineers lies in the temperature limitations which, so far, have characterized all nuclear power cycles. Nearly all nuclear power systems in use or in the design stage employ rather low steam temperatures. The highest steam temperature of any power reactor anywhere up to the present time is the 488 F used in the recently completed 5000-kw Argonne Boiling Water Reactor plant. The steam pressure used is 600 psi. The British Calder Hall station, which began operation on October 15 of last year and which is the largest nuclear power plant in the world, operates at a steam pressure of only 185 psi and a temperature of 575 F.

These are very low temperatures and pressures when compared to the steam temperatures and pressures used in modern fuel-fired power plants. Indeed, these were the values in general use some 25 or 30 years ago. Since our modern high-efficiency stations are designed for temperatures of from 1000 to 1100 F and pressures of from 1500 to 5000 psi, it is understandable that most power engineers have little interest in going back to temperatures and pressures that were in use a quarter of a century ago. They are interested in the development of nuclear reactors operating at much higher temperatures. Power engineers are very conscious about high thermal efficiency and they know that this efficiency is a function of high temperature.

This striving for high thermal efficiency, says A. W. Kramer in our companion publication *Atomics*, has influenced the design of at least two proposed nuclear power plants, to the extent that separate oil-fired superheaters are provided to superheat the steam after it has been produced in the nuclear system. Such plants, therefore, are not truly nuclear plants, because they depend in part upon the use of conventional fuel. They will even have smokestacks.

What Efficiency Costs

Nuclear reactor engineers are also interested in developing higher-temperature reactors; but to them high temperature does not seem as important as it does to power plant engineers. High-temperature operation of nuclear reactors introduces many difficult problems. It involves the use of expensive, often exotic, materials; it requires high rates of heat exchange; corrosion difficulties multiply rapidly at high temperatures; and nuclear power systems are very sensitive to corrosion.

So, when considering going to higher temperatures, the nuclear reactor designer will wonder whether the increased thermal efficiency is worth the cost and effort. From the nuclear engineer's viewpoint, thermal efficiency is not as important a factor as it is to the power engineer. When fuel costs are high, thermal efficiency is of great importance but its importance decreases as fuel costs go down.

For example, if in the case of a coal-fired plant the fuel cost was 50 per cent of the total cost of power, it would be of great importance to attain high thermal efficiency. In a nuclear power plant, however, where the fuel cost might be only 20 per cent of the total power cost, the designers would consider very carefully whether or not a higher thermal efficiency could be justified. It is, of course, difficult at the present time to accurately estimate nuclear fuel costs, for these will vary with the type and degree of enrichment and production costs in various countries. In the U. S. we have natural uranium available at $18.20 per pound. At this rate, the U-235 content is worth about $5.20 per gram. Enriched fuel costs considerably more; but, as Dr. Walter Zinn pointed out recently, the first small degree of enrichment is the most expensive. As the amount of enrichment increases, the cost per gram of U-235 becomes lower. With 10 per cent enrichment, the cost per gram of U-235 is $15.25 but, with 90 per cent enrichment, it is only $17.07.

Three Kinds of Lies

Economics of nuclear power plant development remains in a rather nebulous state. The fact is, as Dr. Norman Hillberry, director of Argonne National Laboratory, stated in a talk before the American Power Conference, nobody knows what nuclear power plants will cost until we actually build some for commercial use. Dr. Hillberry referred to Mark Twain's classification of the three kinds of lies, to wit: lies, damn lies, and statistics. That, said Hillberry, was probably true when Mark Twain said it; but if he were alive today, he might classify the three kinds of lies this way: lies, damn lies, and *nuclear power cost estimates*.

There are, of course, several reasons why we have not gone ahead faster in building commercial nuclear power plants in this country. The primary one is that there is no economic need for such plants at the present time because of the abundance and cheapness of conventional fuels. We are not impelled by the same sense of urgency that prevails in Britain, where conventional fuel resources are close to exhaustion. Another reason lies in the fact that our private public utility companies are regulated with respect to rate schedules and profit margins, therefore they cannot afford to spend large amounts of money in development programs that might not bring immediate return on the investments. So far, the government has been doing nearly all the research and development in the field of nuclear power; the ratio is about 10 to 1.

False Complacency

From the standpoint of long-range development it is perhaps unfortunate that we have a comparative abundance of conventional fuel in this country because it gives us a false sense of complacency. There is a general feeling that our fuel reserves are so vast that there is no need to develop nuclear power. This view, however, fails to consider the tremendous growth in the use of power throughout the entire world. In the U. S., as in other industrial countries, the power load has been doubling every 10 years and there is no reason to believe that this rate of growth will not continue. Last year we used 160,000,000 tons of coal plus 75,000,000 barrels of oil and something over a trillion cubic feet of gas in producing the electrical energy used in this country.

By 1967, we will need 320,000,000 tons of coal alone, and in the late 1970s the coal requirements will rise to 640,000,000 tons. Regardless of the state of our existing reserves at that time, it is unlikely that we will have the manpower and techniques to produce such ever-increasing quantities.

So we will have to find some new source of power. Our hydroelectric capacity will not be able to augment our power supply materially, nor does solar energy promise much in the way of large scale power development. Nuclear power, therefore, is the only answer to the long-range power question.

From the time of inception to the time of start-up, it takes from 5 to 7 years to build a large nuclear power plant. Then two or three years of operation are needed before reliable cost figures become available to prove its economic feasibility. It is quite evident that none of the first-round plants will be able to produce economically competitive power. The second round may come close to it.

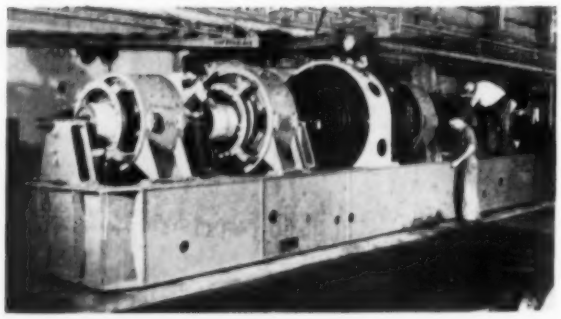
But the time is short. We have just about 20 years at most. If we start now on a full-scale commercial nuclear power program — as England is doing, and as Euratom expects to do — then, in 20 years when we will really need nuclear power, we will have it.

(Photo by Hamilton Wright)

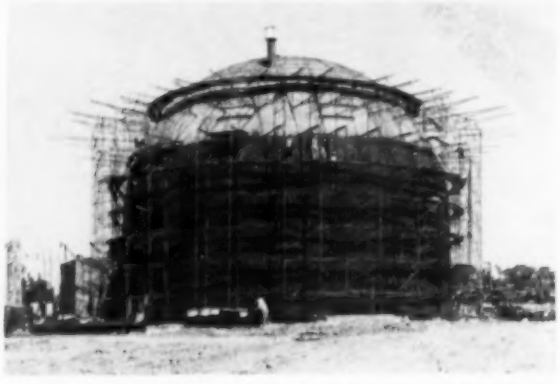
Hydro Plant in Rugged Country goes up in Columbia, South America. One of a series of power projects for Columbia's National Public Service Corp, Laguneta hydro plant will have a capacity of 60,000 kw. With turbines by S. Morgan Smith, generators from GE, engineering and construction are by Gilbert Assoc., Frederick Snare Corp

POWER ENGINEERING'S

Site of Future Atomic Energy Plant, this hole in the ground will hold big steel sphere that houses nuclear reactor for proposed Dresden Station of Commonwealth Edison Co of Chicago. Dual-cycle boiling water reactor plant by the General Electric Co will produce 180,000 kw



Biggest Motor-Generator Sets ever constructed by GE drive 55-cu yd power shovel on strip mines in Kentucky

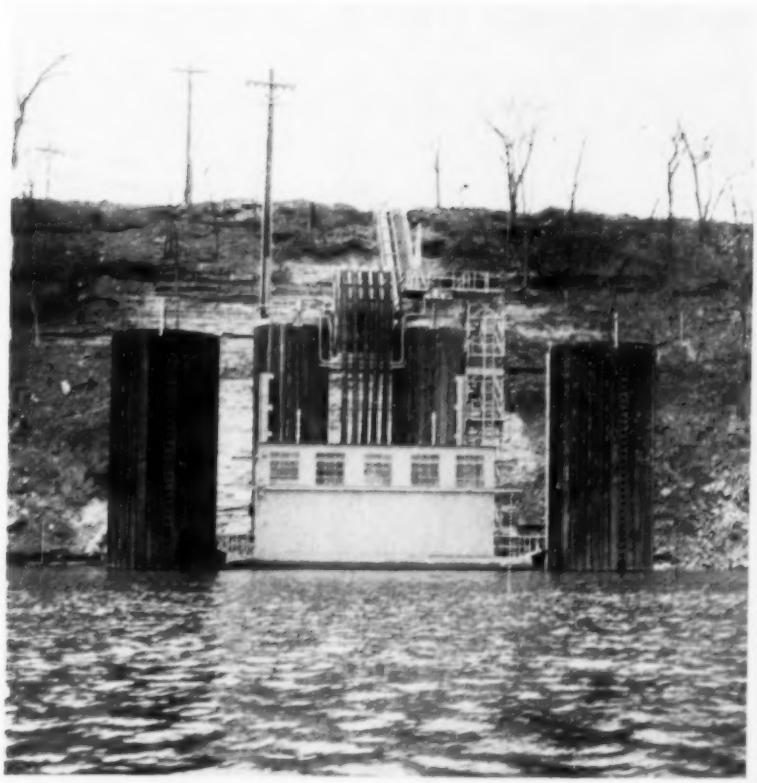


Insulating the Atom: Foamglas blocks insulate Argonne Laboratory's Boiling Water Reactor, now in full operation

Conventional vs Nuclear Power is dramatized by this photo of Army Base in Antarctic showing barrels of diesel oil needed to fuel 2000-kw electric generating station for about three months. Golf ball in inset shows amount of enriched uranium that would do the same job in new Army Package Power Reactor just built by ALCO Products, Inc

King-Sized Low Pressure Turbine Cover for 300,000-kw unit by Allis-Chalmers for Detroit Edison is checked by officials of United Engineers & Constructors, A-C, Edison Co

NEWS REEL



Floating Pump House Rises, Falls with River: Ford Motor Co plant in Tennessee utilizes floating pump house made by Dravo Corp to cope with river

Lamp To Burn 100 Years is turned on by R. J. Cordiner, GE President. Bulb is replica of Edison's first but material, technique improvements will give replica life of over a century

Fig. 1. (Left) Generator shaft truing device as set up to grind shaft without removal from rotor; note V-belt drive from air motor. Fig. 2, above, shows the slip ring arrangement that supplies current to grinder motor on rotating mount

Hydro plants usually face two repair problems: bulky equipment, location remote from big shops; here's how they meet challenge

INGENUITY, KNOW-HOW SOLVE

Maintenance Problems

By LLOYD McWILLIAMS*

SOME THIRTY TO FORTY years ago when the first large vertical hydro-electric generators were installed, designers of the period gave little heed to fit of thrust collars. They allowed a loose fit on the shaft.

A thrust collar rests on top of the Kingsbury bearing, which supports, and on which rotates, the combined weight of the runner, generator rotor, and shaft — over 200 tons, and with modern installations, considerably more. The thrust collar is held in place by a circular key which fits into a circular keyway near the top of the generator shaft. Also, there are keys running parallel with the shaft to take care of turning moments.

In the past, a tolerance of 0.015 in. was allowed between the collar and shaft. This clearance, although small, allowed a slight swing to take place which was absorbed by the guide bearings. Over the years, this added up to trouble, and today many hydro stations are experiencing an epidemic of guide bearing failures, accompanied by severe vibrations in the entire unit. There are records of shaft breakage, and recently, on this system, the wobble in one instance was so great that the exciter armature rubbed the pole pieces. Result: fireworks.

For a considerable time the real cause of the trouble was not understood, and attempts were made to correct shaft swing by changing and shimming guide bearings. On old turbines these bearings have liners of lignum vitae, rubber, and one of the resinous bonded materials. All are water lubricated. But due to stresses imposed, they were again defective in a few months. To be replacing bearings in the 30-in. size continuously is costly maintenance. Also, the generator guide bearings, which are of babbit, frequently became wiped and had to be renewed.

Thrust Collars Guilty

About five years ago, the real cause of undue swing was traced directly to the thrust collars. That loose fit of a few thousandths of an inch had, after millions of turns of the shaft, increased to a degree where the bearings would not hold the vertical shaft in its true position. It was found that some collars had increased their original inside diameter by $\frac{1}{16}$ in; in many cases the shaft had taken a severe pounding.

Although the collar (not shown) was loose on the shaft, the metal of the shaft and collar had, due to pounding, "cold-welded" together. In removing the collar it was necessary to put dry ice inside the hollow shaft, apply heat to the collar, and use the pull of two 100-ton jacks.

There are several methods by which a thrust collar can be rebuilt: The shaft, if necessary, can be removed from the rotor, turned down, then have oversize sleeves shrunk on. This is a very costly undertaking, since it is usually necessary to send the shaft to a large engineering shop for machining.

Rebuilding the inner diameter of collars by metallizing has been employed on small units, but since there is no fusion of the metals, it was feared that this method would not stand up to the stress imposed on large machines.

What is believed to be a comparatively new approach to the problem has recently been tried out with great success.

Use Electrolytic Plating

Upon removing a thrust collar and finding it must be rebuilt, it is first machined to remove all faulty metal. It is then sent to a firm who specialize in plating by the electrolytic process. For thrust collars, nickel is deposited since nickel is machinable; chrome must be ground.

Generally, a deposit of about 0.050 in. is sufficient on the wall to bring

*The Shawinigan Water & Power Co

Fig. 3. Boring bronze bushing attached to rotating plate; clearance of 0.003-in. was allowed for fit over the shaft

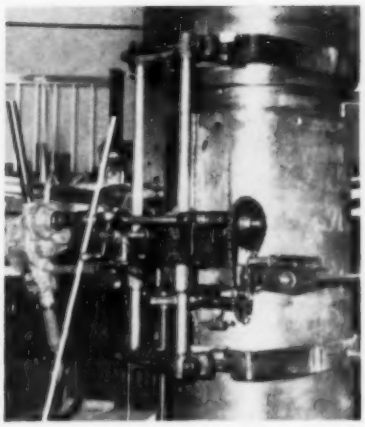


Fig. 4. Old keyway cutter was altered to fit generator shaft, damaged keyway cleaned up, new step key fitted

Fig. 5. Here's how repaired keyway looked after completion of job. Making this repair without pulling 30-ton shaft from generator rotor saved time and money

In a Hydro Plant

a collar back to size with allowance for machining.

Since collars are now bored undersize to allow for a shrink fit, a sufficient deposit must be allowed. For a 30-in. shaft an allowance of 0.002 to 0.004 in. is the rule in this shop. Collar is heated slowly (10 to 12 hrs) by placing electric heaters inside and bringing the temperature up to 200 F. Do not force the heating because these collars are cast iron.

Roundness Essential

Assuming it has not been necessary to remove and turn down the shaft, careful checks must be made with micrometers to ascertain that it is not oval. Recently a newly rebuilt collar was replaced on a shaft that was only 0.002-in. oval. Considerable time was lost to line up, and it was necessary to put shims between the running plate and the collar to correct the alignment.

A schedule has now been drawn up to inspect the thrust collars on all units that were installed twenty-five years back. It is of the utmost importance that collars be corrected before the shaft has suffered damage.

Removal of a shaft that needs truing up from the rotor of a large generator is a time consuming, costly undertaking.

In recent years, our Company has had to pull several shafts and ship them to a large engineering works to be machined. Naturally, this makes for lengthy down time on a unit.

Upon dismantling a 10,000-kva unit recently, the shaft was found to be badly bruised and out of true. The thrust collar was oval.

After failing to pull the shaft with two 100-ton jacks, applying heat to the hub, and dry ice to the shaft, it was decided to try and devise some means of redressing the shaft in place. (This rotor hub was not of the split and bolted type.)

Since the section of the shaft below the thrust collar and the shoulder on which the collar rests were quite true, there was no hesitation about using these areas as bearing surfaces to rotate the contraption shown in Figs. 1 and 2.

Driven by Air Drill

Main parts of the mechanism consist of a 34-in. diameter, V-grooved wheel, cut from 2-in. steel plate. A bronze bushing with flange was attached to the wheel and machined. A clearance of only 0.003 in. with the shaft was allowed. A thrust bearing consisting of a brass retaining ring with 72 quarter-inch bearing balls was fitted between the under side of the wheel and the shaft shoulder. A grinding unit with cross and vertical feeds was attached to a bracket on top of the wheel. Entire unit was turned by power supplied by a reciprocating type air drill.

Obviously, this job was accomplished with makeshift equipment; however, with refinements, and a design of more rugged proportions, there is no reason why shafts of larger diameter cannot be turned or ground in the same fashion.

Upon removing a faulty thrust collar from one of our generators, it was found that the longitudinal keyway on the 24-in. shaft was damaged. The 2-in. key had been rolling in the keyway and could not be reused.

Old Joes Use Wits

At first we were inclined to pull the 30-ton shaft from the rotor and ship it to a large shop to be machined. Fortunately, however, there are still a few old Joes in circulation who got their early training on a mower or binding machine and had to use their wits to keep things moving. One such old timer resurrected a 10-in. keyway cutting machine from the basement of the powerhouse, where it had lain forgotten for years. Some minor changes were made, it was clamped to the shaft, equipped with cutters, and the job was on (Fig. 4). Driving power was an air drill.

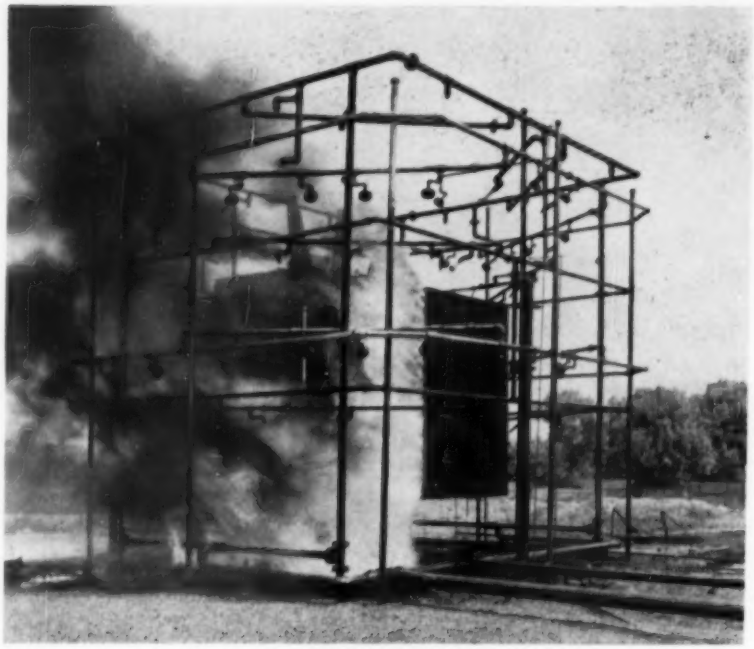
An oversize step-key was made to fit the now oversize keyway. A job that could have otherwise run into weeks, was done in five days (Fig. 5), at less cost. As our old timers say, "Use your head, save your back" and, *we* add, "lots of money."

Is There a *Best* Way to Extinguish Transformer Fires?

NEW METHOD OF demonstrating the comparative effectiveness of fire protection systems for high-voltage transformers has been devised by Automatic Sprinkler Corp of America at their test grounds in Youngstown, Ohio.

Aware of the varying needs of those who require fire protection for this purpose, the Special Hazards Division of the company has erected a full-scale model of a 22,000-kva transformer surrounded by a piping system that enables a test crew to simulate any one of the many nozzle configurations commonly employed on such systems. Hot oil, similar to that used in transformers, is piped to five locations on the model. When oil at any one — or several — of these spots is ignited, the effectiveness of any of the nozzle patterns in extinguishing the fire can be judged accurately.

Automatic Sprinkler plans a series of test demonstrations during the coming months to which interested personnel from the utilities will be invited. At these tests, observers will take part in conducting the tests and specifying test conditions. POWER ENGINEERING will soon publish a complete report on this program.



Fire test on full-scale model of 22,000-kva transformer. Surrounding piping is set up to take variety of nozzle patterns for water or CO_2 extinguishment of fires

FCI Meeting Discusses Standards

Members of Fluid Control Institute at Spring meeting. Front row, third from left, John S. Leslie, new president of FCI. Rear right corner, Executive Editor Earle

SPRING MEETING of the Fluid Controls Institute, Inc was held at The Greenbrier, White Sulphur Springs, W. Va. on May 9 and 10, Over sixty members and guests were present, representing all prominent manufacturers of automatic regulating valves, control valves, solenoid valves, space heating specialties, steam and gas traps, and steam heating pumps.

President John C. Koch of Conoflow Corp presided over the meeting on May 9. Product Section meetings were held for the study and development of various standards for voluntary acceptance by the industry and users.

On May 10, a panel discussion was held by three members of the Institute on the following subjects: Neil Skinner of Hoffman Specialty Mfg Corp, Philosophy of Management in Small Business; W. F. Hurlburt, Jr. of Automatic Switch Co, Building a New Plant; Fred Weldon of General Contro!s Co, Advantages and Problems of Export Sales.

Following officers were elected at the meeting to serve for the coming year: President, John S. Leslie, Leslie Co; Vice President, Dean E. Madden, A. W. Cash Valve Mfg Corp; Vice President, Marshall B. Taft, Minneapolis-Honeywell Valve Div; Treasurer, Paul K. Rogers, Jr., Skinner Chuck Co; Secretary, Edward J. Glinske, Jr., Cochrane Corp.

Missile radomes made from Pyroceram protect instruments from high temperatures experienced in supersonic flight

PYROCERAM FACT SHEET

Strength (flexural) — Up to 40,000 psi; experimental types up to 60,000 psi

Weight — Sp. gr. 2.40 to 2.62

Strength-to-weight ratio — 14.1 for Pyroceram Code 8605, compared with 13.3 for dense alumina, 14.3 for aluminum, 10.1 for stainless steel

Hardness — Harder than fused silica, cast iron, stainless steel, titanium; 27 times harder than plate glass

Softening temperature — Up to 1350 C (2460 F)

Porosity — Gas tight

Color — White opaque or clear

Structure — Polycrystalline oxide

Electrical properties — Extremely low loss factor at high frequencies, high temperatures; high dielectric constant at high frequencies

Chemical stability — Pyroceram Code 8607 is nearly as resistant to acid attack as borosilicate glass; more resistant to alkali attack

Thermal expansion — Can range from slightly negative to 200 x 10^{-7} per degree C, compared to 95 x 10^{-7}/°C for stainless steel

Thermal conductivity — At .010 cgs units, Pyroceram Code 8605 has 4 times the conductivity of borosilicate glasses

New Material for Higher Speeds and Temperatures

DEVELOPMENT OF a whole family of new wonder materials has been announced by Corning Glass Works.

They are tough, heat-resistant substances, harder than high carbon steel, lighter than aluminum and nine times stronger than plate glass, according to Corning scientists. "Pyroceram" is Corning's trademark for these new crystalline materials made from glass.

The first commercial use of Pyroceram will be in radomes — nose cones for guided missiles. The cone of Pyroceram protects the sensitive directional instruments in the nose of the missile from the sudden high temperature experienced in supersonic flight. The softening point of this Pyroceram is 2640 F, which is above the melting point of some stainless steels.

Over 400 different Pyroceram compositions have been developed at Corning's research laboratories. The material can be tailor-made with thermal expansions ranging from slightly negative to high enough to match those of heavy metals. It can have electrical insulating properties said to be superior to those of the best commercial dielectric ceramics; and flexural strengths as high as 60,000 lb per sq in.

Corning scientists call the new materials an answer to industry's growing demand for higher speeds and higher temperatures. Listed as first possible uses for Pyroceram are: parts for supersonic aircraft; jet engine components; piping for chemical and oil-refining industries; curtain walls and other uses in architecture.

Pyroceram is made by adding special ingredients to the raw materials of a glass batch. After the glass has been cooled to solid form, it goes through a heat-treating process. This transforms it from glass into an extremely hard, fine-grained substance.

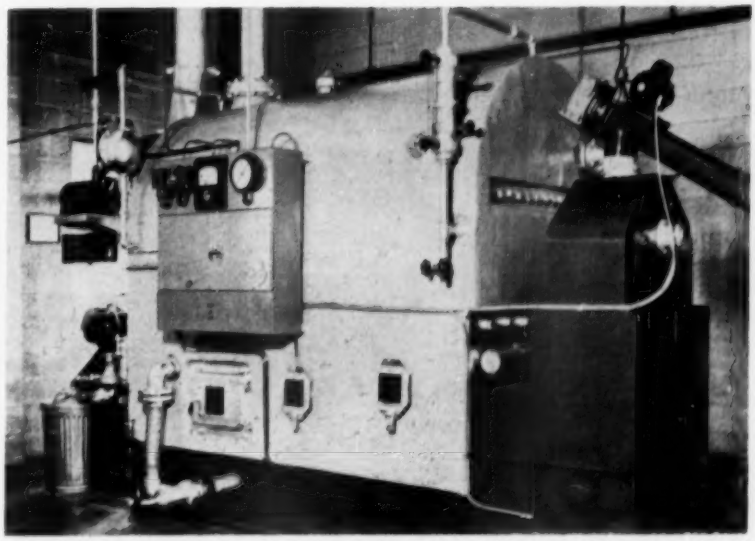
Cost of Pyroceram is expected to be little more than glass and much less than stainless steel.

Research Produces a New Package Steam Generator

FIRST FOUR units of the new coal-fired automatic steam generator developed by Bituminous Coal Research, Inc, are being built for two establishments in the Columbus, Ohio, area. The International Boiler Works Co is making the units for Walter J. Engel, Inc, wholesale florists, and Otterbein College of Westerville.

Design of this equipment has been engineered for unit installation in commercial and small industrial plants. Suitable for either steam or hot water heating, the BCR automatic steam generator utilizes a water-cooled pulsating grate, a water-tube boiler, and coal-feed and ash-removal automatically controlled by a BCR-patented control system.

The BCR steam generator is a substantially smaller unit than conventional stoker-boiler plants with the same output and is competitive with oil-fired units. The unit will be manufactured in six sizes ranging from about 2500 to 10,000 lb of steam per hr and pressures up to 160 psi.



New BCR steam generator is a stoker-boiler which will burn a wide range of coal smokelessly and permit continuous mechanical ash removal, automatic operation

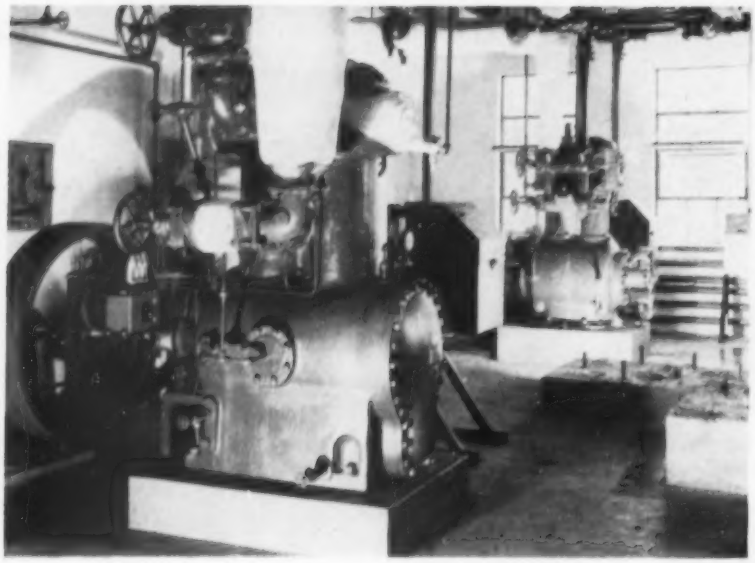


Fig. 1. Dramatic illumination with floodlights is always an attention-getter. If exposure is long enough, picture has excellent depth of field

By TERRY MITCHELL, M.E.
Engineer, Frick Company

How To Take Power Plant Photographs

MORE PHOTOGRAPHS of machinery are being taken all the time; more and more people are interested in how to make them properly. Nothing is more useful than an excellent picture, and nothing is worse than a poor one!

If possible, secure the services of a commercial photographer who is accustomed to handling indoor pictures of industrial subjects. The pictures should be taken with a camera of size 4- by 5-in. or larger. Panchromatic film should be used, as this is sensitive to colors and produces pictures with better tone values, even in black-and-white.

In taking views of the outside of a plant, wait until the grounds are cleared of scaffolds, paper, building materials and unattractive trucks or automobiles. Outside pictures showing snow on the ground are generally not as pleasing as those with darker surroundings. The exteriors of buildings generally look dead unless the sun is shining.

In engine rooms, begin by putting the place in apple-pie order. Remove coats, brooms, buckets, waste-baskets, tools and trash. Be sure that ladders, particularly, are out of sight. Have the dust and oil wiped off machines, motors and foundations. (Oil spots on cement can be covered with powdered chalk or lime.)

Decide on the views that will show the equipment and the plant as a whole to the very best advantage. Concentrate on securing two or three superb pictures instead of five or ten indifferent ones. Wait until the sun is in the best position to give a pleasing light. Life is added to any picture if people are included; they should be posed looking at the equipment, or talking to one other, and must not be staring at the camera.

More pictures are spoiled because of the glare from electric lights and windows, in front of the camera, than from all other causes put together. The time necessary to cover all the sources of light in front of the camera is well spent. The silver paper in which films are packed makes an excellent fireproof shield for masking of lights.

Dark areas must be illuminated with ample photoflood or flashlights. With floodlights, a very small opening of the shutter on the camera can be used, if the exposure is long enough — from half a minute to five minutes. The resulting picture will have both near and far objects in sharp focus. This is what photogra-

Fig. 2. Careful placing of the camera keeps posts from obscuring center of interest in this view. Be sure the plant is first put in apple-pie order

Fig. 3. Jumbled, confused, without strong focus on subject, this is wrong approach to photographing these condensers

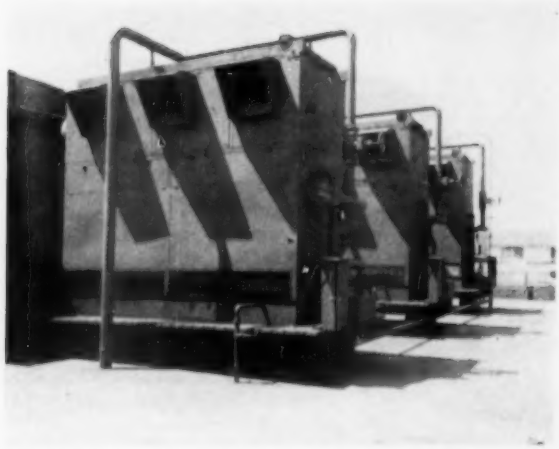


Fig. 4. Same condensers, photographed the right way. The camera is placed to make the equipment loom up impressively

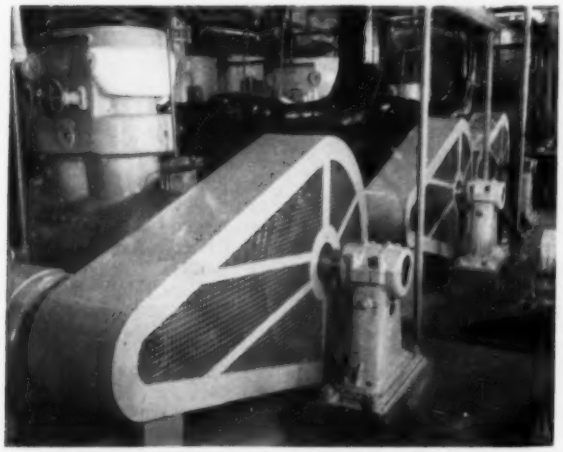


Fig. 5. Sometimes, though, a dramatic angle can spoil the whole. Here belt guards and outboard bearings hog the view

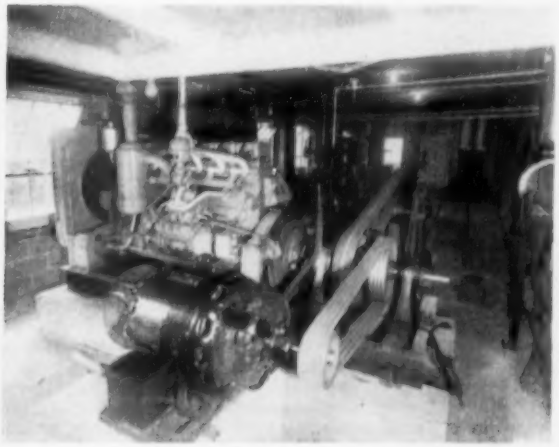


Fig. 6. Tilting camera downward distorted vertical lines here, flattening out subject. Also, lighting in rear is poor

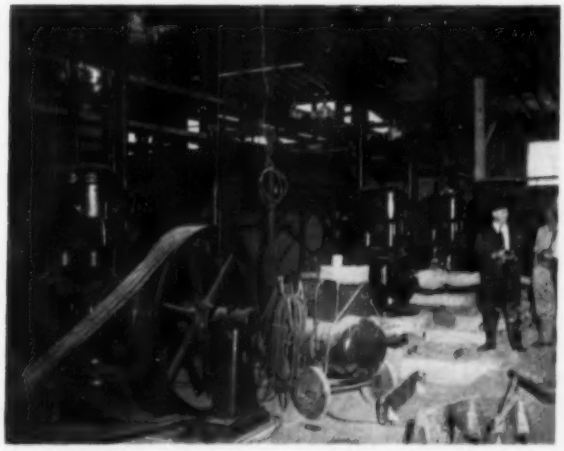


Fig. 7. "Construction" views like this seldom have permanent value. Besides, this one is underexposed, confusing

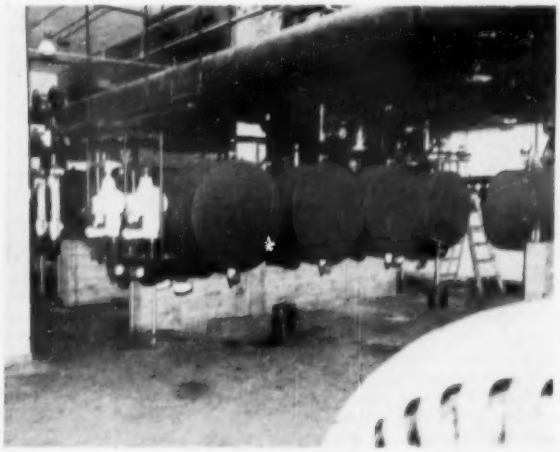


Fig. 8. This shows what results when the area is not properly cleaned up before photographing. Also underexposed

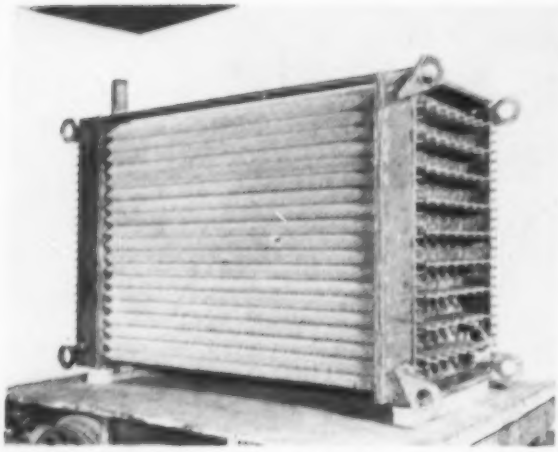


Fig. 9. A difficult subject well photographed. The exceptional sharpness is achieved by careful lighting. Lights may be moved during exposure but must never shine on lens

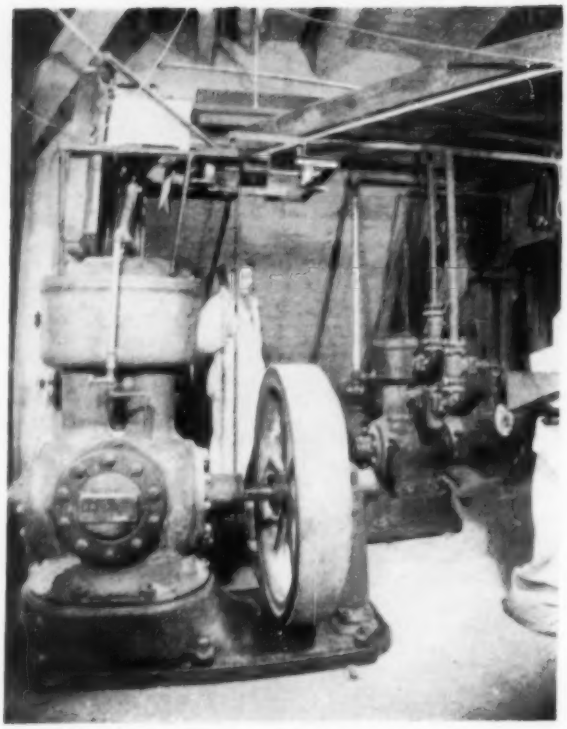


Fig. 10. A wide-angle lens is often necessary to get comprehensive view, but here its use in a close-up has given curved edges to picture, as it may for a very wide angle

phers usually call "depth of field."

The lights may be moved during the exposure, if desired, but must never shine on the camera lens. It is a favorite trick of mine to paint sunlight on dark subjects with the aid of a mirror; you can throw a strong beam of light for hundreds of feet by this method.

With flash bulbs, the exposure is only about 1/50th of a second and the diaphragm must be at least half-way open. Two or more flash bulbs may be needed, to light up distant spots. Dark machines require more light than the faces of people; hence any figures included should be placed farther from the light.

Where suitable lighting cannot be obtained, surprisingly good pictures can be taken with Tri-X film, which has a speed of 160, as opposed to a speed of 64 for Verichrome Panchromatic with artificial lighting. Place the lights to give contrasting shadows; a single flash bulb, set off close to the camera, will give a "flat" effect. Remember that in most engine rooms you need more light on the floor and less on the ceiling.

Pictures taken from an angle are more interesting than "square" or head-on views. Ask the photographer to move the lens down in the slot so that more of the floor and less of the ceiling will show. A wide-angle lens is often necessary to get a comprehensive view. But distortion at the edges of the picture is common with lenses covering a very wide angle.

The film holder on the camera *must stand vertical in both directions,* otherwise the pipes and similar perpendicular lines will slant in a way that cannot be corrected in the picture, even by the usual retouching. Many cameras have the front part hinged, so that the lens can be pointed downward or upward, while the film is still vertical.

Look on the ground glass of the camera before each exposure is made and satisfy yourself that the vertical lines are vertical, and that the best possible view is being obtained. Watch out for vibration if the camera is standing near moving machinery. Avoid also the reflected glare of windows, known as "ghosts." If you must shoot into a room through an open door or window, place a shield of cardboard or cloth over the camera to protect the lens from the glare of the outside light.

Secure signed releases from any person who appears in the photograph, as otherwise there may be suits for damages, if dissatisfaction arises. Something must be given in exchange, or the release has no legal value. A simple form of release such as the following is generally satisfactory: "In exchange for a print of the photograph, representing value received, I agree to the use of my picture, taken this date, in advertising or for other publicity purposes."

This release should be dated and signed by a witness. It should be signed by the parent or guardian of a minor, but if a person is being paid for working when the picture is taken, and makes no objection when his employer has given permission for the photograph to be made, he has little legal right to complain when the pictures are published, unless they show him in an embarrassing way.

When the prints are mailed, be careful not to injure them with wire clips. Do not write on the back of the prints with a typewriter or heavy pencil. The impression which shows on the front side makes trouble for the engravers. On the reverse margin of each picture, write with light pencil or pen strokes the name and location of the plant and the date; also the names of any people in the view. Photographs placed in the mails should be protected by double sets of corrugated cardboard of good quality, on both sides, making four pieces in all.

Editor's Note: A useful addition to the power engineer's bag of tricks, photographically speaking, is the Polaroid Land camera. This camera takes pictures which provide a finished print about one minute after the shutter is snapped.

Biggest advantage of this system of photography, especially for the amateur, is the opportunity it gives to determine immediately the adequacy of the picture just taken. If there has been an error in lighting, focus, or composition, a correction can be made on the spot and the picture retaken.

These cameras have been used to advantage for recording progress of maintenance and repair work, condition of equipment at overhaul, and similar purposes.

Automation Raises Power Supply Problems

Decentralization and automation in manufacturing plants bring new problems in power supply, due to voltage variations and short-time interruptions. Here are two viewpoints on this important subject; that of the manufacturer, and that of the power company

MANY NEW WORDS have been added to our vocabularies in the past few years of rapid technological progress, one of which is the term *automation*. The more or less general use of this term is somewhat unfortunate because it seems to have a different meaning to every group which gathers to discuss it.

If automation means doing things automatically, the power industry has been a leader in automaticity and has established an enviable record for continuity of service. Power plants have been outstanding examples of automation for many years. Now, however, with the increased automaticity of manufacturing plants, the power industry is about to become the victim of its own fine service record.

For many years, most manufacturing was performed in compact industrial areas with high electric load density. There was some manufacturing in outlying suburban areas, but generally neither large in magnitude nor complex in nature. In the postwar era, however, particularly in the last five years, manufacturing expansion has been such that many large manufacturing plants have moved into suburban areas; i.e., decentralized. Such movement has included, in almost every case, an element which is, or was, frequently overlooked by both the power company and the plant engineers. This element is the modernization of equipment, and here modernization means increase in automaticity.

This increase in automaticity brought into use more sensitive equipment, that is, equipment more sensitive to voltage variations, and as a consequence, such voltage dips or transients resulted in shut-downs, some of which proved very expensive. The manufacturers, of course, blamed the power companies for these outages. The power companies, on the other hand, feel that such sparsely settled areas cannot expect the unvarying voltage conditions that normally exist in our large cities, and they contend that the problem is one the manufacturers should solve themselves.

This problem was the subject of an interesting discussion at the American Power Conference meeting in Chicago. It was presented from two different viewpoints; first, from the viewpoint of the power company, and, second, from the viewpoint of the manufacturing company. C. E. Quick of Detroit Edison presented the problem from the utility standpoint; Frank Dixon of the Ford Motor Co. discussed it from the manufacturers' standpoint.

When the customers' complaints began to come in, Mr. Quick said, one thing stood out clearly; equipment builders of all kinds assumed an absolutely continuous electric power supply. Such a continuous power supply, however, is not available in suburban or remote areas where the transmission is by overhead lines and in most cases involves only one source. With the full cooperation of the customers, the Detroit Edison Co made a number of tests of motor-driven machines. These tests indicated that voltage dips as great as 90 per cent for as long as 30 cycles had little effect on either the work piece or the tools.

Effect of Voltage Dips

It was concluded, therefore, that the controls on many machines were more sensitive to voltage dip than was necessary for the protection of the machines. The operating characteristics of the control components of modern automated equipment are not compatible with a practical power system design. Careful consideration of the voltage dip problem by automated equipment designers can eliminate much of the trouble, either by direct circuit rearrangement or by the utilization of voltage stabilizing devices; such as the motor-generator and the constant voltage output transformer.

Serious as the problem is for the manufacturers, it is obvious that the power companies, regardless of how much they are willing to cooperate, cannot provide 100 per cent uninterrupted service. Transients are likely to occur on all systems and when control equipment on machines are sensitive to transients of the order of from 2 to 90 cycles varying from 2 to 80 per cent of normal voltage, outages must be expected. In the case of the Ford Motor Co, the restarting time for much of the equipment was four hours at first, but later this was reduced to two hours.

The power companies fully recognize the seriousness of the problem, and they must be prepared to advise or assist the manufacturers in applying corrective measures to the troubled equipments, nor can they rest on past laurels for service continuity. They must continue their efforts to minimize the voltage dips on their systems. At the same time, the manufacturers of control equipment and of the automated machines must take this problem into consideration in the design of every component device or piece of equipment going into a system.

Electronic computers are particularly sensitive to short voltage dips and at Ford a great deal of trouble was had with the computers even after voltage stabilizers had been installed on the systems. One day, by accident, one of the computers giving trouble was plugged into an unstabilized line. The trouble ceased for a while and after the trouble was studied it was concluded that the output wave shape of the voltage stabilized affected the computer's operation.

At the present time Ford is polling some of the major utilities for indications of what the computer manufacturers may expect. When this information is obtained they will recommend that computer manufacturers design their equipment to conform with normal utility operations. Ford believes that the voltage stabilizer is the least costly approach to the problem of voltage variation, with the exception of electronic computers where wave shape is a consideration.

There are many other ramifications to this problem of electric system design and operation but the aspects presented here are among the most important. It is obvious that the system must be considered as a whole with every piece of equipment attached to it coördinated properly with the system characteristics. Also, as systems grow in size and power concentrations become higher the stability problems become more serious. Undoubtedly, the trend will be toward the use of automatic operation in all instances where the economics justify the use of such equipment. Here, however, F. J. Lane, Deputy Chief Engineer of the Central Electricity Authority in the United Kingdom issued a word of warning. He wondered whether, on automatically controlled power systems, the operators would be able to take over in times of emergency when the automatic equipment failed to function. As it is now, Mr. Lane pointed out that the operators are thoroughly conversant with every detail and are able to act fast and intelligently in times of trouble. He doubted that that would be so where the system normally functioned automatically. So far, Mr. Lane pointed out, the British 275-kv transmission system was under manual control.

Should Spare B-F Pump Start Be Automatic Or Manual?

By IGOR J. KARASSIK *

AS WAS MENTIONED in the article last month (POWER ENGINEERING, June 1957, pp. 76–77), a spare boiler feed pump may either be arranged for automatic starting on loss of header pressure or started manually, at the choice of the operator. Here again, the decision between these two arrangements is to a great extent based on the personal preference of the operators, although the general design of the steam power plant may have some direct bearing on this decision.

To begin with, modern steam power plants are less vulnerable to interruption of feedwater supply than was the case with stoker-fired units in the past. Rapid interruption of firing makes it possible to avoid the disastrous results of a sudden boiler feed pump failure. On the other hand, there is still insufficient experience in the operation of super-pressure units to enable us to make this statement with respect to power plants operating above the critical steam pressure.

The number of boiler feed pumps installed likewise has an effect on the choice of starting methods. If two half-capacity boiler feed pumps serve the unit, failure of one of these pumps will obviously jeopardize the power plant to a lesser degree than the failure of a single full-capacity pump. Thus there is considerably more justification in providing a quick automatic start-up of the spare pump in the latter case.

But quite apart from the matter of choice between automatic and manual starting, the spare boiler feed pump should always be held ready to start with the minimum of delay. This means that the suction and discharge valves should remain open, the check valve preventing reverse flow through the pump. It is recommended that the pump be maintained at or near operating temperature. This is accomplished variously by providing flow through the open suction and out through a warm-up valve or through a jumper line around the check valve from the discharge header into the suction.

No matter what system is employed, it is imperative that the pump be kept at a uniform temperature throughout, since unequal heating leads to distortion and is very likely to cause serious damage on starting. In other words, it is very dangerous to start a pump which is half-hot and half-cold.

In addition to the warm-up problems, there are a number of auxiliary services to be considered. These include such items as cooling water to stuffing boxes and to coolers in the lubrication system, by-pass protection against overheating at light flows, and so on. Certain of these services need not be supplied as long as the pump is idle. Others must be maintained whether the pump is running or not. In this last category we must place the condensate sealing water supply on boiler feed pumps provided with so-called "packless" stuffing boxes.

Obviously, if the spare pump is always started manually, the time involved in opening cooling water connections prior to start-up is negligible and it is certainly a great advantage to save cooling water by shutting it off when the pump is idle. On the other hand, automatically started spare pumps should have no delay in supplying this auxiliary service. The added expense of automatic controls and the added risk in the failure of these controls must be weighed against the savings in cooling water which they provide.

Common Spare Pumps

One of the means available for the reduction in initial investment costs without a complete elimination of standby equipment is the use of a common spare boiler feed pump for two adjacent units. The general arrangement of a two-unit open cycle power plant with a common spare pump is illustrated on Fig. 1. It will be noticed that in addition to the usual suction and discharge valves for each individual pump which is intended to serve one particular unit, it becomes necessary to provide separate valves in the suction and discharge lines of the spare pump in order to isolate it entirely from the unit which it is not serving at the particular moment.

The reason for this isolation is that the two units may be operating at different loads and therefore at different heater pressures and temperatures. If no means were provided to isolate the two systems at the suction, flow could take place from one suction header into the other, resulting in steam binding of one of the headers. The same holds true of the discharge lines, as one unit may be operating at a higher discharge pressure than the other and lack of isolation would shut the check valve on the pumps which have the lower discharge pressure.

Of course, the simplest solution would be to keep valves A, B, F and G closed, opening that combination of valves which permits the inclusion of the spare pump into the unit which requires it just prior to starting the pump. There is, however, a distinct danger in this solution: if both sets of valves are left closed, leakage of feedwater at the stuffing box would ultimately empty the spare pump down to a level even with the bottom of the stuffing box glands. On starting up, the pump would be air bound and could readily seize at the running joints.

It follows, therefore, that the better part of valor is to keep one set of valves open — either A and F or B and G in Fig. 1. In this manner, the pump would be connected into the right unit in 50 per cent of the emergency cases which call for the use of the spare pump. This would correspond to an arrangement where one unit is provided with a regular spare pump while the other unit can be provided with a spare pump in a reasonably short period of time.

This period of time will depend, of course, on the means used to switch the pump from one unit into the other. Here again, at the expense of a few automatic controls, the spare pump can be switched automatically: valves A, B, F and G can be motorized and arranged to operate automatically on loss of header pressure in either unit. Time delay relays must be incorporated so that the pump itself cannot be started until after the proper set of valves has been opened and the other set is closed.

This switching of the spare pump from one unit into the other may be dangerous. Most modern high pressure installations have a wide range in feedwater temperatures between full and light load. If the spare pump were connected into the unit which is carrying a higher load than the other, and if suddenly it became necessary to switch it to the unit carrying a lighter load, the pump would be full of feedwater at a temperature having a vapor pressure in excess of the suction pressure. This would lead to steam binding and possibly serious damage to the pump.

To avoid such a possibility, it is recommended that the pump always be connected into the unit carrying the lowest load. While one could argue that the probability of the pump failure is somewhat affected by the load carried by the unit at any particular time, the distinction is unnecessarily complex and we can readily assume that the statistical probabilities of having the spare pump included in the system which requires its use remain at the 50 per cent value previously mentioned.

It is rather obvious that each of

* Assistant to vice-president, and consulting engineer, Harrison Division, Worthington Corp.

the five pumps shown in Fig. 1 could be made to serve the role of a spare pump for either of the two units. This would merely require the inclusion of additional feedwater lines and valves so as to route both suction and discharge to and from each pump alternately into Unit No. 1 or Unit No. 2. It is as obvious, however, that such an arrangement entails considerably more expense and complexity, and that the additional expense and risk are probably not justified in preference to an additional spare pump. The latter solution, of course, would make each unit completely independent of any other unit in the plant.

This complexity indicates that common spares may be justified for adjacent units but that when more than two units are involved, it becomes extremely difficult to make a single spare pump serve all units.

We should not fail to discuss at this point several of the auxiliary services which may be affected by the fact that the spare pump may be used with one of two different units.

Protection Against Overheating

Normally, the by-pass recirculation is returned to the deaerating heater in open cycles and to the condenser or to a low pressure heater if a closed feedwater cycle is used. If a common spare is used for two adjacent units, several alternate arrangements can be worked out successfully.

(1) The by-pass line may be branded so as to lead to the chosen return in either unit. A valve is provided in each branch and its control is integrated with the control of the suction and discharge valves, so that the proper terminus for the by-pass line is always provided.

(2) The valves in these two branches can be operated manually. If, in 50 per cent of the cases the recirculation returns to a unit other than is served by the spare pump at the moment, the unbalance is taken care of by overflow in one unit and additional make-up in the other. The duration of the unbalance would not probably be such as to cause any difficulty.

(3) The recirculation water could be made to return to the pump suction after passing through a heat exchanger where the heat absorbed in the pump would be removed.

Frankly, my preference is definitely on the side of the second solution. The use of a heat exchanger seriously complicates the installation and adds unnecessary expense. The same may be said of the first arrangement.

Balancing Device Leak-Off

The most important word of caution about the balancing device leak-off is that *under no circumstances* should the pump be permitted to operate with a closed valve in this line. In the case of closed cycles, the leak-off is generally returned to the individual pump suction and no valves are included in the leak-off return. But when an open cycle is used, the leak-off is almost always returned to the deaerating heater. The only valve in the return line is an isolating valve which is always locked and open except when a pump is withdrawn for inspection and overhaul.

Here again, as in the case of the by-pass recirculation, the balancing device leak-off line could be made to branch into two separate heaters. If the variations in the back pressure are not too marked, the slight unbalance resulting from returning the leak-off to the wrong heater is probably immaterial. If, however, such variations lead to an unbalance which the pump manufacturer considers harmful to the pump, it is better to return the leak-off of the spare pump to the pump suction.

Should the temperature rise of the leak-off be considered too high for safe operation under all conditions, it is always possible to include a small heat exchanger in the return line, as shown on Fig. 2. This heat exchanger can be located in series with the oil cooler in the lubrication system since only a small amount of heat need be removed from the leak-off.

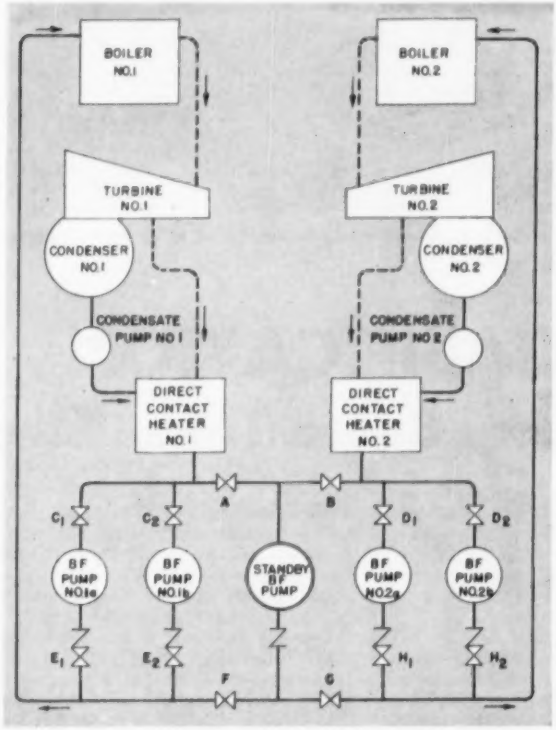


Fig. 1. General arrangement of a two-unit open cycle plant with common spare pump. This reduces initial investment costs

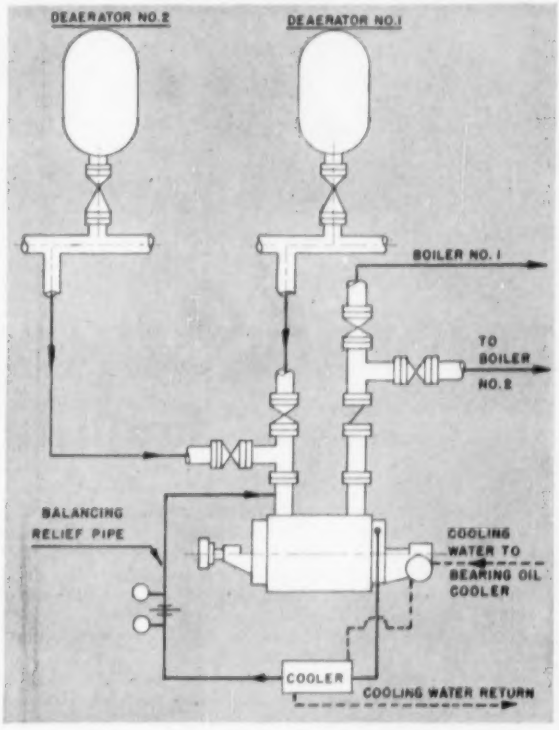


Fig. 2. Balancing device leak-off for feed pump serving two separate systems. Small heat exchanger can be in return line

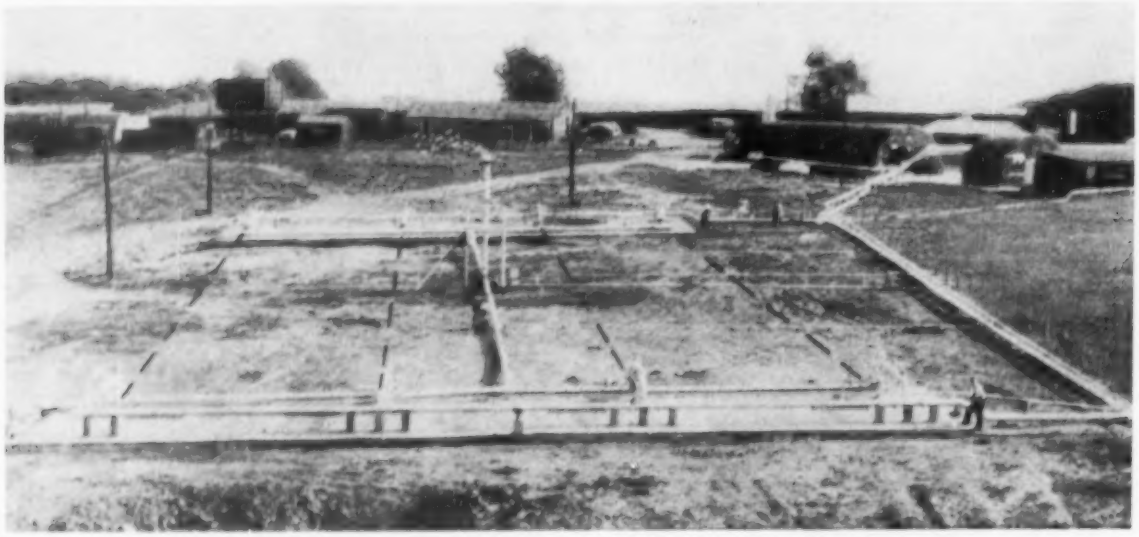


Fig. 1. Site of underground gasification field experiment by gallery-to-gallery method. Gas issues from stack in center

UNDERGROUND GASIFICATION . . .
English Coal Board Takes Steps

CONVERTING underground coal into heat-laden gas by burning the coal right in the mine has long been more than a theoretical possibility. Experiments in underground gasification of coal have been carried out in seven different countries, including the United States. However, the low efficiency of the methods thus far employed prevented widespread practical use of the plan — at least, in this and other countries where the fuel supply is not critical.

Great Britain, on the other hand, grows daily more dependent on the importation of fuels. In that country, the economics of the situation, coupled with recent gasification methods developed there, combine to make the process feasible, and an engineering firm has been given a contract for work on a pilot scheme.

A spokesman for the firm stated: "There are hundreds of millions of tons of coal in Britain which are unminable by ordinary means, but which may be exploited by the underground gasification process.

"At present, effort is being concentrated on using the gas to produce electric power, and it is hoped that the cost of using such fuel in power stations will be less than that of oil fuel or nuclear energy. If the pilot plant is successful, a full scale 60,000-kw power is likely to be built; this would use about 1000 tons of coal a day by underground gasification."

Current plans call for the pilot plant to be in operation by the end of 1958 and gas delivered to a five megawatt generating plant to be built by the Central Electricity Authority. Coal seam at Newman Spinney (near Sheffield) is of secondary quality, not worth mining because of its high ash content.

Exact process to be used is not re-

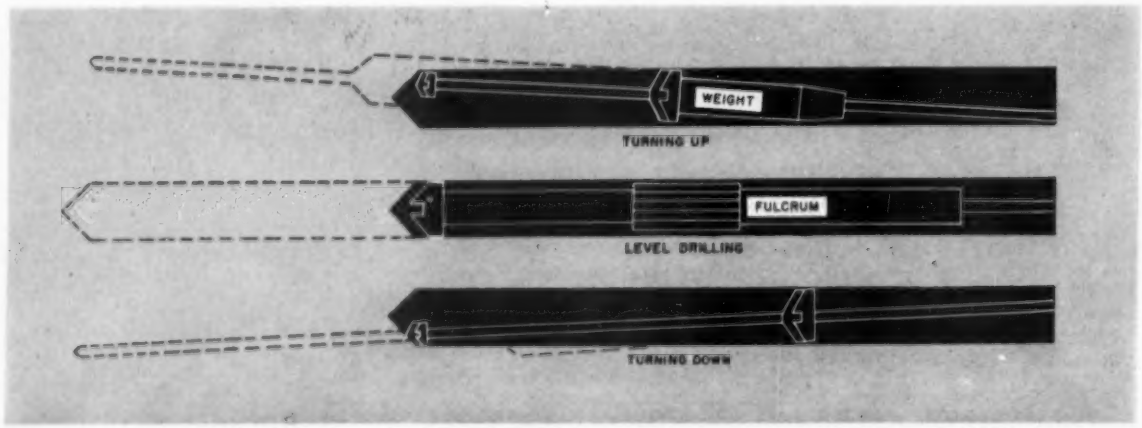


Fig. 2. Diagrammatic sketch of method used to direct drill bits upward or downward when drilling through narrow seams

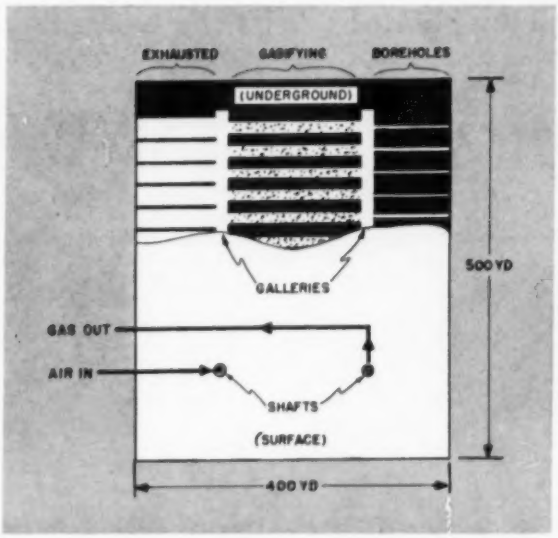


Fig. 3. Diagram of gallery-to-gallery method of gasifying

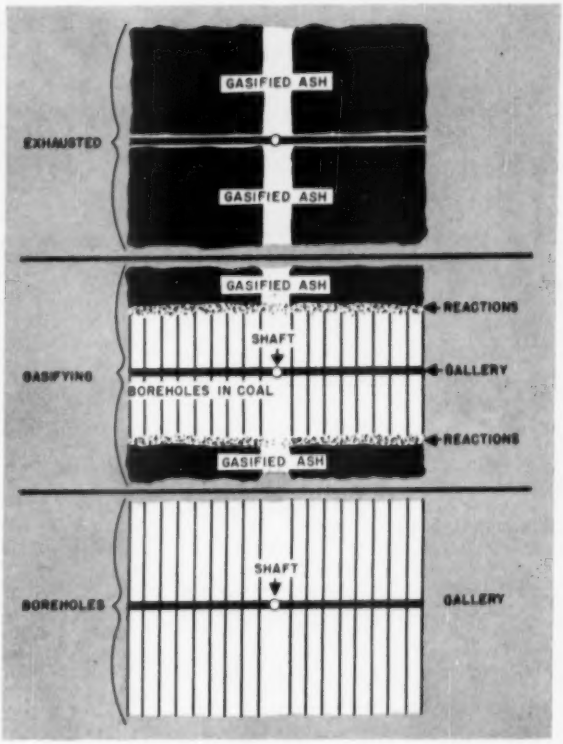


Fig. 4. Possible layout of blind borehole method of drilling

To Make It Work

vealed, but it is likely to be one described in a paper by Masterman and Montagnon of the Ministry of Fuel and Power before a Joint Solid Fuels Conference, Washington, D. C.*

Process of underground gasification consists in making access to, and through, a coal seam, setting fire to the coal, blowing air into the burning coal and taking out gas at the other end. Generally, a low quality gas is produced — under 100 Btu/cu ft — consisting of producer gas with some water gas and volatiles. Use of oxygen and steam instead of, or with, the air can improve gas quality.

At a calorific value under 100 Btu/cu ft, the gas can best be used under boilers or in gas engines to generate electricity.

In Great Britain, over 50 field trials on two sites, with six different seams of coal, were conducted during a seven-year period. Non-coking and medium coking coals were included in the trials and no great difference was found in their gasifying performance.

Two methods were found to be practical: gallery-to-gallery and blind borehole method. Each required drilling long directional holes in the seams from previously prepared galleries. Techniques of directing the drilling are sketched in Fig. 2.

Object, of course, is to keep the bit in the coal seam for long distances; indicative of their success in this technique is a record of keeping the bit in the coal for nearly 200 yd without passing out of a 3-ft-thick seam.

Gallery-to-gallery method is shown in Fig. 3; parallel boreholes are drilled from one gallery to another, the boreholes being spaced about 10 to 30 yd apart. Air is pumped through an access shaft into one gallery from which it passes through the boreholes, gasifies the coal, then passes into the second gallery and up an exit shaft to the surface.

Area shown in Fig. 1 was gasified by this method. Seam was 2½-ft thick and about 1700 tons of coal were gasified in 4-month operation. Gas costs of this method indicate a range of 1½d to 3½d per therm compared to present cost of coal at pithead in Great Britain of nearly 4d per therm, and imported fuel more than 6d (about $0.07).

An even more promising method is the blind borehole process, the elements of which are shown in Fig. 5. Here, a borehole is drilled in the seam and the far end left blind; a loosely-fitting pipe is inserted in the hole to convey air to the far end and the gases from the reaction return around the pipe. A full-scale system might be set up as indicated in Fig. 4.

Costs have been calculated for a known area of about four square miles. At this site there are four gasifiable seams, each containing about 12,000,000 tons of coal, of which about 10,000,000 tons could be gasified. Each seam, therefore, could serve to generate 60 mw at 45 per cent load factor for about 50 years. If gasification is carried to a maximum depth of about 1000 ft, the gas costs amount to about 1½d per therm with a further ¼d for an additional 1000 ft of depth. Since it now costs nearly 4d per therm to extract coal by normal mining in Britain, the process appears to be justifiable.

Engineering contractors for the recently-announced pilot scheme will plan a full-size power station while work goes forward on the developmental pilot plant project.

* Underground Gasification in Great Britain, by C. A. Masterman and P. E. Montagnon, Ministry of Fuel and Power, London, England, presented before ASME Joint Solid Fuels Conference, Washington, D. C., October 25–26, 1956.

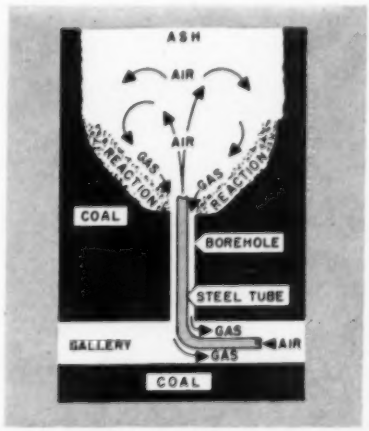


Fig. 5. Principle of the blind borehole

Steam leakage through the packing glands of a steam turbine

Here's a Quick Review of

By HARRY E. MORGAN*

STEAM TURBINES are provided with packing glands at the shaft ends and governor valve lifting rods to prevent steam leaking out of the turbine when the pressure in the casing is above atmospheric, and to prevent leakage of air into the casing when the pressure is below atmospheric. The latter condition exists at the exhaust end of a condensing turbine at all times; it exists at the inlet end of a condensing turbine only at start-up and at light loads until enough steam flows through the turbine to build up the first-stage pressure above atmospheric. Air is excluded by introducing enough sealing steam into the gland to keep the pressures in the gland above atmospheric so that air cannot leak in.

Carbon Rings

One of the early sealing methods used was the stuffing box with flexible metallic packing, which was later replaced with carbon rings. Carbon rings are still being used for sealing single-stage and some multi-stage turbines and in conjunction with labyrinth seals. The labyrinth type of sealing system is now prevalent for the larger turbines.

A typical three-ring carbon packing box and carbon rings is shown in Fig. 1. The carbon ring comes in three segments, held together by a garter spring. A clip connected to the spring prevents the ring from rotating and the steam pressure on the high pressure side of the gland will keep the carbon ring against the packing box partitions to provide a sealing function. Provision is made for steam sealing if the rings are used in a condensing turbine, with the drain connected to the sump, or to an ejector to maintain a slight vacuum between the two outer rings.

Carbon rings produce a very effective seal with small leakages. The number of rings used varies with the pressure to be sealed. In some turbines, 10 to 12 rings have been used for pressures up to 200 psig. However, their use now is generally restricted to lower pressures.

A carbon-ring seal will function properly as long as there are no excessive clearances or breakage. Its operation can be affected adversely by sludge that sometimes accumulates in the carbon ring box, which prevents the ring from moving freely. A slight shaft vibration might cause the rings to break. There is also the possibility of rough spots developing on the shaft from corrosion which will cause rapid wear. To reduce this possibility the shaft may be chrome plated or sprayed with stainless steel where the carbon rings make contact, or a renewable sleeve may be used. Carbon rings can be easily checked against these adverse conditions, however, because inspection and replacement of rings can be done by removing only the packing box cover.

Labyrinth Seals

The labyrinth seal, shown in Fig. 2, is especially designed for modern turbine operation. It operates satisfactorily without actual contact between the shaft and the stationary member of the seal. The clearances may be from 0.005-in. to 0.015-in. on the radius. The seal consists of very thin strips of metal, with spaces between them, that project to the shaft. As the steam leaks past each strip, through the small opening between the shaft and the strips, there is a drop in pressure over each strip.

The velocity generated with each drop in pressure must be dissipated through turbulence in each space before the steam reaches the next strip. Alternate short and long strips, or the stepped-labyrinth type, are more effective than strips of equal length. The more times the steam is throttled, or the more throttling rings or strips used, the less leakage there will be for any given pressure drop.

In the illustration (Fig. 2), the seal consists of seven rings. The six inner rings each have eight throttling strips, and the outer ring has four. The rings consist of four pieces, each positioned in a groove by two coil springs to make a flexible mounting, a safeguard if the shaft makes contact and rubs the ring.

For additional safety, when the temperatures do not exceed 600 F, the rings are made of soft bronze and have thin edges, so rubbing will not generate enough heat to cause damage. Stainless is used, however, when temperatures exceed 600 F. All the seal rings, except the inner three, which can be removed only by removing the turbine casing cover, can be replaced by removing the packing-box cover.

Since carbon rings are satisfactory for lower pressures, generally under 75 psig, they are sometimes used in combination with a labyrinth seal that acts as a pressure breakdown (Fig. 3). The pressure between the labyrinth and the carbon ring is limited by bleeding off the leaking steam through the exhaust in a non-con-

* De Laval Steam Turbine Co

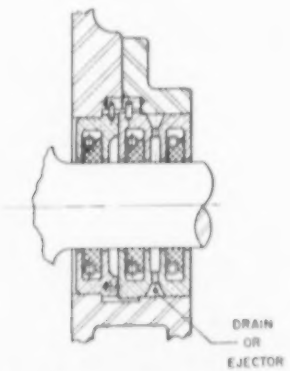


Fig. 1. Assembly of carbon packing box and carbon rings

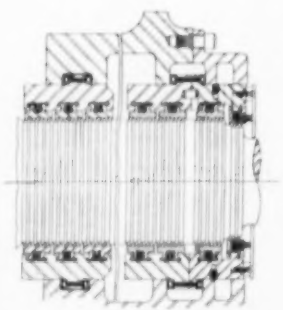


Fig. 2. Labyrinth seal is much used for large turbines

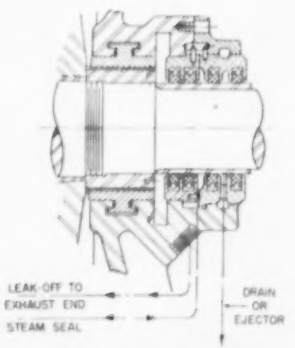


Fig. 3. Labyrinth seal and carbon rings can be combined

means loss of efficiency. Keep it to a minimum by using effective seals

Turbine Sealing Methods

densing turbine, or through a low-pressure stage in a condensing type.

Gland Seal for Shaft Ends

A complete gland seal for shaft ends consists of three parts. In addition to the carbon-ring or labyrinth seals, there is usually a steam-seal system and a gland exhauster system, as shown in Figs. 4 and 5. The steam-seal system prevents the leakage of air into the turbine and disposes of the steam that leaks past the shaft packing. A leak-off takes the steam that leaks past the labyrinths in the high-pressure packing gland to a low-pressure stage of the turbine. The steam seal delivers steam to the shaft packing and maintains a set pressure of 1 to 2 psig at all times to prevent the entrance of air. A relief valve protects the system for excessive pressure. An exhaust system consisting of water ejectors (Fig. 4) maintains a vacuum of about 6 in. of water in the packing leak-off.

Exhauster System

The exhauster system keeps a slight vacuum on the gland between the steam seal and the atmosphere by maintaining a flow of steam to the exhauster system from the steam seal. The subsequent flow of air inward acts to prevent the steam from leaking from system to the atmosphere.

Figure 5 illustrates a typical exhauster system. The steam condenses in a water-cooled condenser, and the air is removed from the system and discharged to the atmosphere by a motor-driven fan. Other methods are also available for creating a vacuum on the gland-seal system. The use of a particular system depends on the amount of leakage and on the preference of the user or manufacturer.

The simplest exhauster system uses ejectors with either water or steam as the operating medium. The disadvantage of steam lies in the fact that it is not condensed when it is discharged from the system to the atmosphere, whereas water will condense the leaking steam. In a variation, condensate water is sprayed and mixed with the leaking steam and air. The condensed steam, spray water and air are then exhausted from the system through a vacuum pump.

The use of all labyrinth seals has made the gland-seal system very important because the effectiveness of the labyrinth seal depends on a certain amount of steam leakage, which must be controlled to some extent by the pressure differential across the seals.

In a condensing turbine, the steam seal pressure must be controlled within close limits by supplying steam from an outside source before starting the turbine and at light loads and by dumping excess steam at higher loads. The successful operation of the seal depends upon how well this is accomplished. For this purpose a steam seal pressure regulator is supplied that will supply seal steam when the pressure in the system is $\frac{1}{2}$ to 1 psig and will dump excess steam when the pressure rises to $1\frac{1}{2}$ to 2 psig.

In a non-condensing turbine, the steam-seal pressure is always positive, and it is only necessary to relieve the excess steam to maintain constant pressure. There must be provision for disposing of a certain amount of steam at a pressure of 1 to 10 psig by connecting to a heater or low-pressure exhaust-steam line. It is important to keep the steam-seal pressure constant on non-condensing as well as condensing turbines, because this pressure controls the flow of steam to the exhauster system.

Valve-Stem Leakage

Leakage also occurs at the valve stems. For low pressures and temperatures, a bushing and a flexible metallic packing have been used in combination (Fig. 6). A bleed-off between the

continued on page 94

Fig. 5 (right). Typical gland exhauster system keeps slight vacuum on the gland between steam seal and the atmosphere

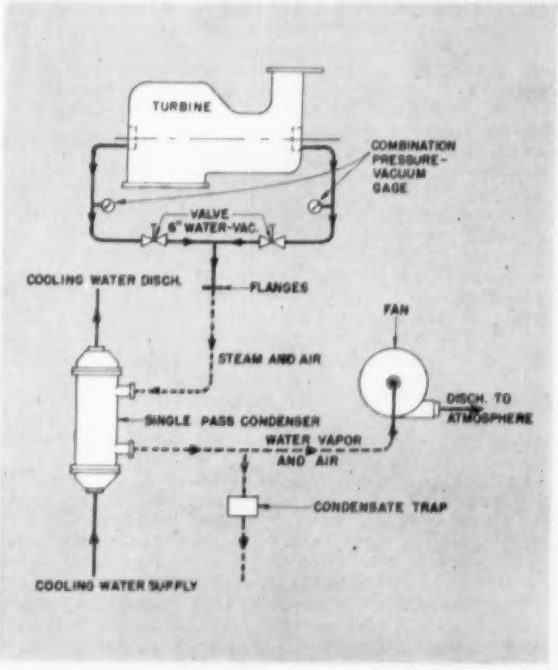
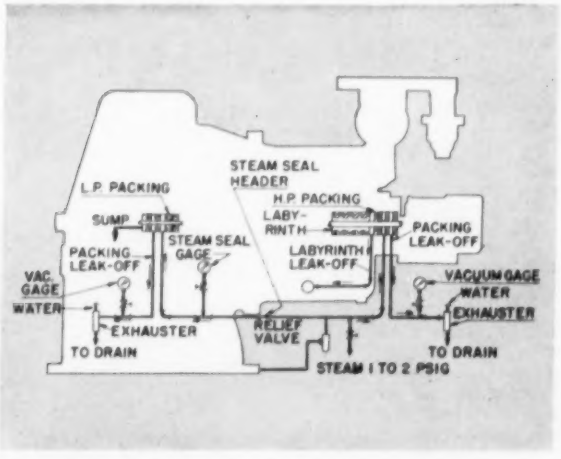


Fig. 4 (below). This scheme shows a steam-seal system, which is used in addition to labyrinth and carbon-ring seals, prevents leak of air into turbine, disposes of leaking steam



Finding Answers
to Refrigeration Problems

BY C. T. BAKER*

AN ARCTIC ice freezing tank rated at 57 tons per day was unable to supply the demands for ice. In spite of all efforts to locate the cause of failure to perform, no improvement was noted. The best the tank would do was 10 to 12 tons per day.

Gage glass on the 16- by 12-in. long liquid ammonia receiver showed the receiver to be three-quarters full. However, when the half-inch hand-expansion valve through which liquid was introduced to the 40-inch diameter shell and tube, single-pass brine cooler was opened wide, no change was noted in the level of the liquid in the receiver gage glass (Fig. 1).

Likewise, the liquid indicator on the brine cooler remained practically constant.

The plant engineer insisted that since the gage showed the receiver to be three-quarters full there was bound to be plenty of ammonia in the system.

Closing the top gage glass valve and leaving the bottom valve open did not cause the level to rise in the glass due to the greater pressure at the bottom of the receiver, which would force the liquid to rise in the glass.

Tapping the receiver top and bottom gave the normal ring of an empty shell. Removing the glass and cracking the bottom valve dislodged an obstruction of oil and particles of dirt. When the glass was replaced, the true liquid level was barely noticeable, showing the receiver to be practically empty.

While awaiting the arrival of a supply of ammonia, the system was checked for oil accumulations. From the brine cooler, cold storage room piping and high pressure oil traps, slightly over one barrel of lubricating oil was removed.

Rate of feed of the mechanical lubricators on the two horizontal double-acting compressors was checked. Each compressor had one oil feed connected to the cylinder, one feed to the suction manifold and one to the oil lantern in the piston rod stuffing box, each of which was adjusted to feed an almost continuous stream of oil. This, coupled with the fact that oil was drawn from the system only twice monthly, explained the reason for the large accumulation.

Oil feed to each point of introduction at both compressors was reduced to three to four drops per minute. Oil is now being drained from the system each week.

It required 1750 lb of ammonia to charge the plant. A check of the entire ammonia piping system with burning sulfur uncovered many leaks, confined largely to flanged joints and valve stuffing boxes.

Condensing Pump Troubles

Principal condensing water pump in this plant was not delivering its capacity. It was rated at 1000 gpm at 90 ft. The pump was directly connected to a 30-hp, 440-v motor. No pressure gages had been provided at the suction inlet and discharge outlet of the pump from which the actual pumping head could be checked; however, a check on the ampere input showed the motor to be 65 per cent loaded.

Figure 2 shows the general arrangement of the water collecting basin and the vertical single-pass condenser supported by the walls of the concrete basin. It will be noted from Fig. 2 that the actual clearance between the end of the suction pipe and the floor of the concrete basin is only 3/4 in.

Since the pump was badly needed, the quickest way to provide additional opening for water to enter the suction pipe was to burn a hole in the 8-in. ell, as indicated in Fig. 2. A gage was placed on the discharge pipe near the pump and a compound gage on the suction line near the pump and the unit placed back in operation. The pressure gages showed the pump to be operating at 88-ft head, and the ammeter showed the pump motor to be operating at 81 per cent of full load. The unit is now handling all the water needed. Just why the suction line was installed as shown in Fig. 2 no one knows. The man who did it has long since gone to greener pastures.

Case of the Rusting Condenser

A few years ago, an ice and cold storage plant installed two identical evaporative-type condensers. They were built by the same manufacturer, and were well designed and well constructed.

Some three years following their installation it was noticed that one of the units showed very definite signs of rust. As time went on, the rust became worse. The interesting thing about this situation was that the other unit, standing close by, showed practically no evidence of rust.

Layout of the new condenser situation is shown in Fig. 3. Sometime following the installation of these condensers, the driveway shown in Fig. 3 was paved with various kinds of sea shells including oyster shells and other marine products used in many sections near the coast for paving private driveways. There was considerable traffic over this driveway both by customers' trucks and delivery trucks of the plant owner.

In dry weather, considerable dust was picked up by the suction of the condenser fan and pulled into the condenser where it was well mixed with both water and air. This action followed each truck that used the driveway.

Test of the water from the basin of the condenser disclosed a pH well on the acid side of the scale. The saline condition of the water caused by the salt in the road material was the direct cause of the rusting, which was quite general in all parts of the condenser.

Driveway has been oiled and a breaker installed close to the air inlet to the condenser. After cleaning the unit of rust and painting all affected areas, the rusting has been practically eliminated.

Reason the companion condenser escaped was that it was being protected by condenser No. 1. Since the driveway was within a few feet of the condenser, the wind drift increased the total salt-bearing content of the air entering the condenser.

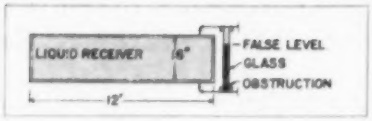


Fig. 1. Case of the ailing ice tank. Why did the gage show three-quarters full?

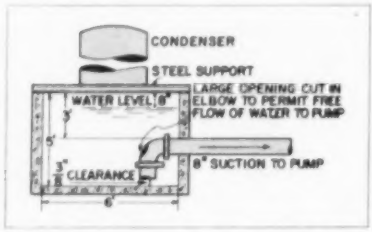


Fig. 2. Hole burned in the 8-in. ell gave another opening for water to enter pipe

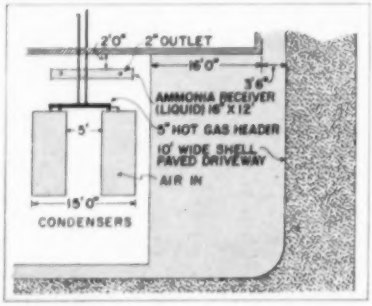


Fig. 3. Case of the rusting condenser. Villain was the shell-paved driveway

*Consulting engineer, Atlanta, Ga.

New Flexible Cushion Coupling Features Rubber Tire

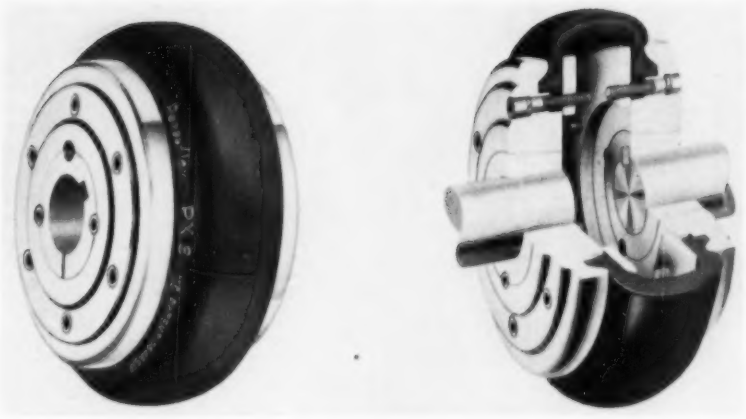


Fig. 1. — Left. Exterior and cut-away views new flexible coupling construction

Fig. 2. — Above. Cut-away section showing tension members in tire of coupling

PARA-FLEX, described as a wholly new conception in flexible couplings, has just been announced.

Ability to handle angular misalignment, parallel misalignment and end float, and in any combination, is only one of many advantages claimed for the coupling. The flexible member is also intended to cushion shock loads and diminish torsional vibration, thus protecting both the driver and the driven machine.

Heart of the Para-flex coupling is a tire with synthetic tension members bonded together in rubber. In fact, this new coupling has been made possible by the technological advance in the manufacture of modern automobile and truck tires, engineered to carry tremendous loads at high speeds and stand terrific shocks. The four-way flexing body of Para-flex, it is stated, outperforms the most complex coupling mechanisms, yet operates with the simplicity and dependability of a modern tire.

The coupling consists of the flexible tire clamped between two hubs, which are mounted on the shafts to be coupled. The flexible member is held between the flanges and clamp rings of the hubs.

Both hubs of the coupling are machined to take Taper-Lock bushings. These give the equivalent of a shrunk-on fit on the shaft and permit quick and easy application to shafts of different diameters without costly reboring.

The tire has a transverse split molded into it, which permits easy installation and makes replacement possible without moving driver or driven machine. To make a change, it is only necessary to loosen the cap screws enough to allow removal of the tire and to fit a new one in place. Even in very confined spaces, this simple operation can be accomplished in a few minutes, it is claimed.

According to its design engineers, Para-flex will take angular mis-alignment up to 4 deg, parallel mis-alignment up to $\frac{1}{4}$ in., and end float up to $\frac{5}{16}$ in. — contingent upon the size of the coupling and the duration of the conditions — or it will take all of these simultaneously. Resilience of the flexible member cushions shocks to a remarkable degree, it is stated, smoothing out the load for both driver and driven machine. Torsional vibration developed by internal combustion engines, the amplitude of which increases greatly at critical points in the speed range, is absorbed to a great degree.

Because there is no metal-to-metal contact in the Para-flex coupling, it requires no lubrication. No maintenance or regular inspection for lubrication is needed. Safety is promoted by flush design — all cap screws are countersunk, metal surfaces are finished all over, there are no protruding parts.

In popular transmission sizes, the couplings are available from factory stock in capacities up to 600 hp at 900 rpm.

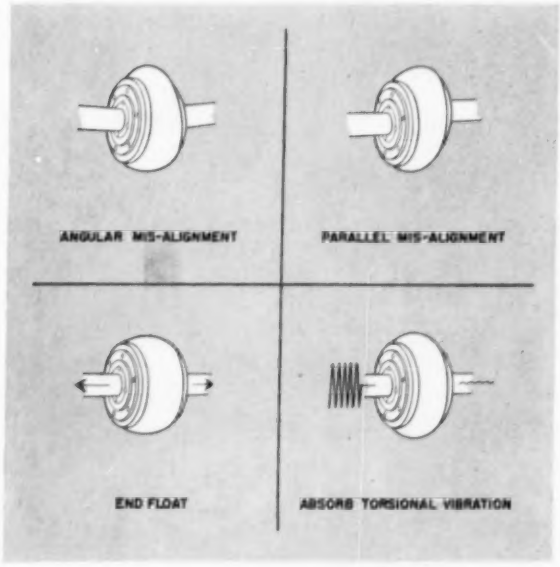


Fig. 3. This shows how the new Para-flex coupling handles mis-alignment, end float and torsional vibration of shafts

For more details on construction, installation and operation of this device, write the Editor, POWER ENGINEERING, 110 S Dearborn St, Chicago 3, Ill., or jot Para-flex coupling on one of the return post cards elsewhere in this issue

Power Engineering handbook

Estimating Cost of Wood Tanks

By O. T. ZIMMERMAN and IRVIN LAVINE *

FOR MANY APPLICATIONS, wood tanks have certain advantages over steel. They require less care and painting, their thermal insulation value is higher, and when used for hard or corrosive waters and many chemicals they often last much longer than steel. Furthermore, unlike steel, wood does not corrode and thereby contaminate materials with which it is in contact.

Many types of wood are used for tanks, including cypress, fir, redwood, yellow pine, poplar, white pine, juniper, oak, and maple. Of these, cypress, fir and redwood are used most extensively.

Cypress is the best tank wood for general use. It is highly resistant to rot; it does not swell or shrink as much as other woods; it resists the action of alkalis, many acids and other chemicals better than other woods; and it does not impart color, taste or odor to liquids.

Unit Weight Cost of Round Wood Tanks

Capacity Gallons	Cost dollars per lb *
100–300	0.38
300–800	0.34
800–2500	0.30
2500–100,000	0.27

* Costs are for cypress tanks, 2-in. and 3-in. thick. For 2-in. redwood or fir, deduct 20%; for 3-in. redwood or fir, deduct 25%.

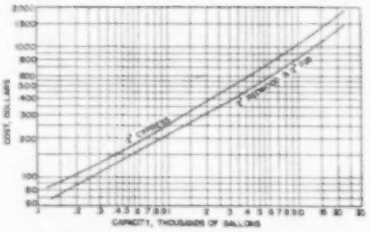


Fig. 1. Cost of round wood tanks, 125–22,000 gal

It is especially suited for holding drinking water, cider, vinegar, fruit syrups and other food products.

Fir has many of the qualities of cypress. It is equal to cypress in resisting the action of certain acids and other chemicals, but it is not as durable as cypress when used with water. However, it costs about 20 per cent less than cypress. It is used particularly for pickles, sauerkraut, and brine solutions.

Redwood is the best of the western woods for tank purposes. It is almost as durable as cypress, and like fir, it is less expensive.

Costs of round wood tanks of cypress, fir and redwood are given in Figs. 1 and 2. All costs are f.o.b. factory and do not include the cost of shipping and erection.

Shipping weights of wood tanks as a

* From *Cost Engineering*, Jan., 1957. The authors are professors of chemical engineering in the University of New Hampshire.

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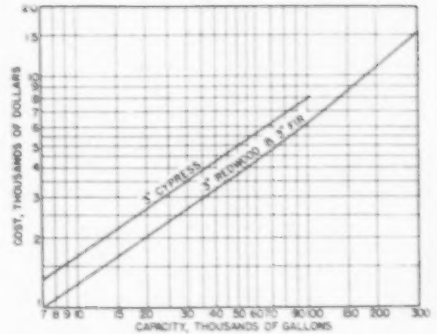

Fig. 2. Cost of round wood tanks, 7,000 to 300,000 gal

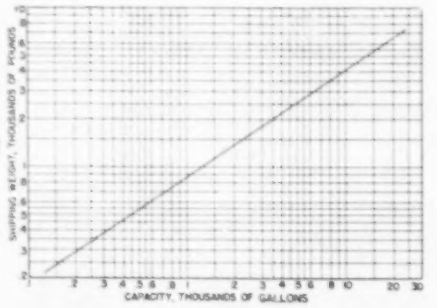

Fig. 3. Shipping weight of round wood tanks, 2-in. thick

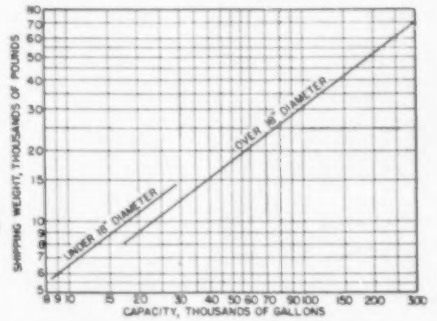

Fig. 4. Shipping weight of round wood tanks, 3-in. thick

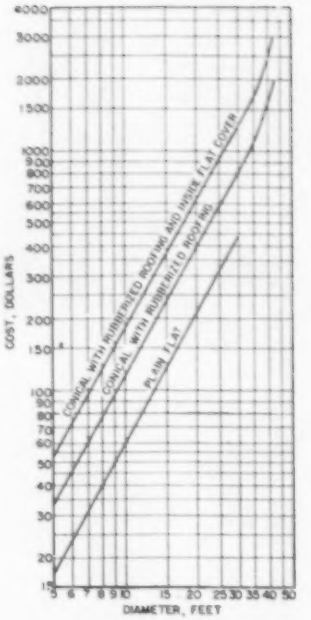

Fig. 5. Cost of covers for round wood tanks

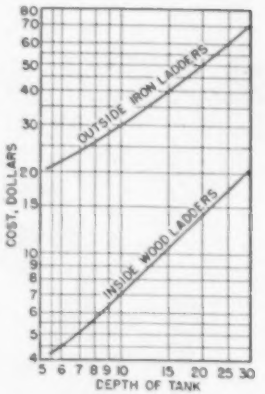

Fig. 6. Cost of ladders, inside and outside

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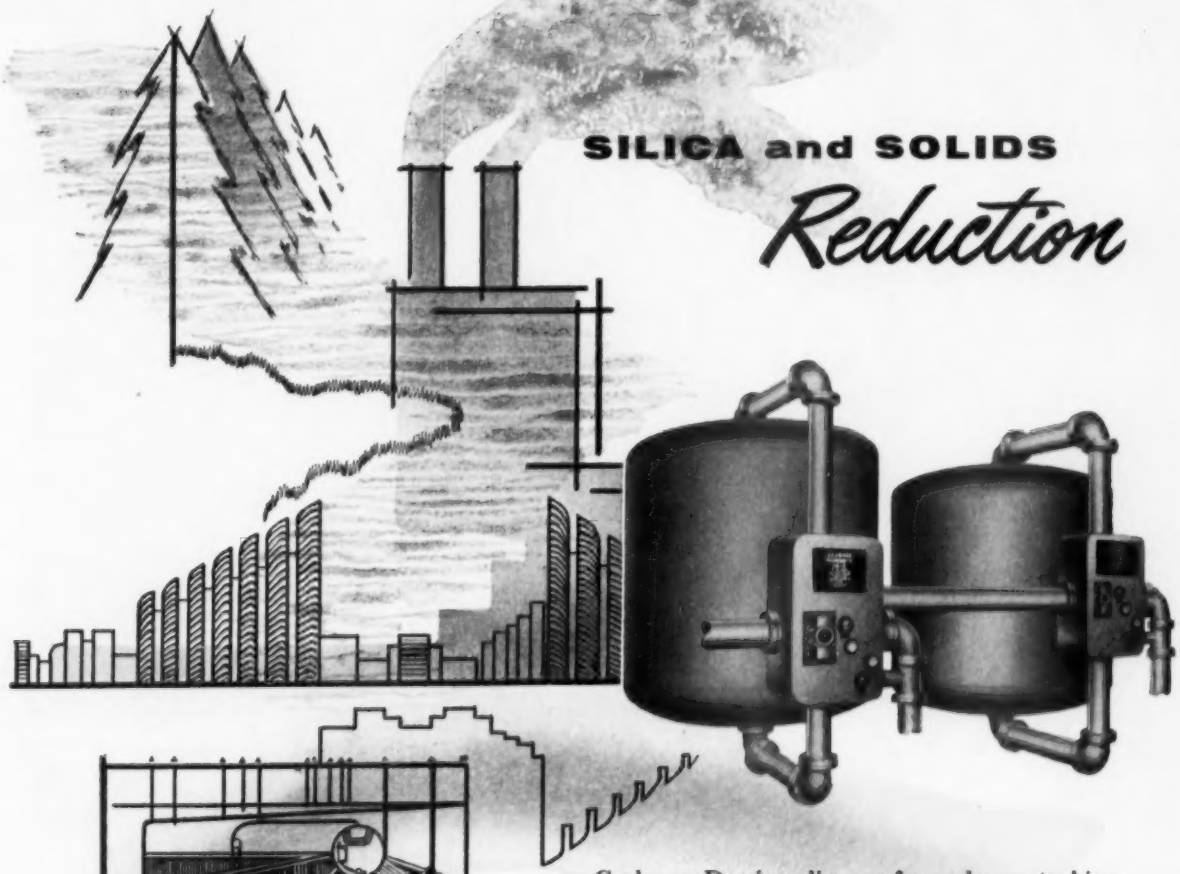

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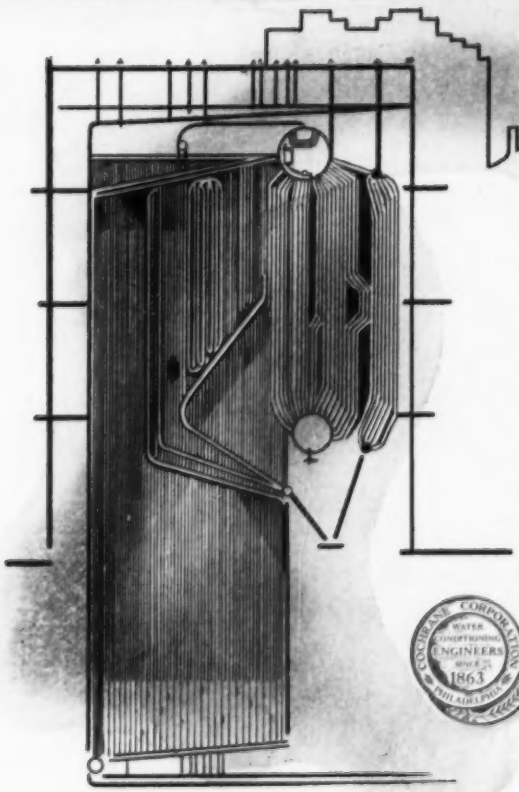

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function of capacity are given in Figs. 3 and 4.

Cost of wood tanks can also be readily estimated from the weight. The cost per pound decreases with increasing size of tank, from $0.38 per lb for a 100-gal tank to $0.27 per lb for tanks of 2500 gal and above. This is shown in the accompanying table.

In many cases, it is desirable to cover the tank to prevent contamination. For indoor tanks, a plain, flat cover is usually satisfactory. For outdoor tanks a conical, weatherproof roof is generally used. The cost of tank covers is given in Fig. 5.

Ladders are a great convenience on any tank. Inside ladders are made of wood; outside ladders usually of iron. The cost of ladders is given in Fig. 6.

Round wood tanks are shipped knocked-down. Erection must be done by skilled labor to insure maximum, leakproof life. Installation costs depend upon local conditions and type of foundation required. For purposes of estimation, however, installation cost can be taken as 50 per cent of the f.o.b. cost.

Three Handy Drill Press Tips

By C. H. WILLEY

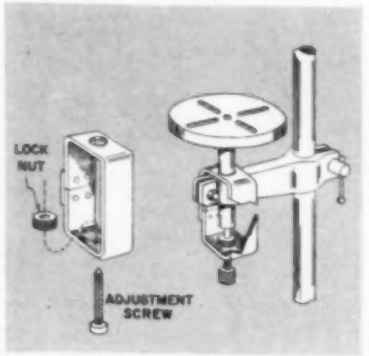


Fig. 1. Drill press table adjuster provides a means of fine height adjustment for small press

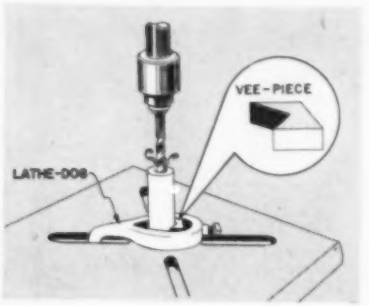


Fig. 2. Lathe dogs, fitted with vee-piece, are handy work holders for safe vertical drilling

HERE ARE THREE handy kinks that we have found useful in drill press work. All are easy enough to make in the average shop and do not require more than average skill.

The drill press table adjuster is adaptable to the small bench-type press with a center-post-mounted table. Its construction is evident from the drawing in Fig. 1. Make the box-like bracket of steel strip at least $\frac{1}{8}$ in. thick. A butt strap of the same material is cut and riveted to close the joint. The bracket stock should be wide enough to provide a strong section at the top after the large hole for the table post is drilled. If desired, two bracing strips (not shown) can be welded across the top edges to strengthen this part of the bracket.

Locknut and adjusting screw are shown knurled, but can be made in other ways to suit convenience. (If hex lock nut is employed, be sure there is enough room to swing a wrench inside the bracket.)

When using this micro table adjustment, center post should be free of burrs and well-oiled to slide in clamp easily. Before applying drilling pressure, tighten the clamp lock bolt to prevent force being transmitted to bracket.

Second item that has proved its usefulness is the lathe dog employed as a work holder. Figure 2 shows how you can hold a rod or shaft vertical for drilling in the press. Long pieces, of course, must be small enough in diameter to pass through the center hole of the table; short pieces of rod are not so limited.

In general, it is best to make a small vee block to fit into the lathe dog — especially if a number of pieces are to be drilled. It is important also that the lower face of the dog be at an exact right angle to the centerline of the clamped cylinder in order that the work is held perfectly parallel with the drill axis.

In similar manner, lathe dogs with the tail upright can frequently be used as convenient holders for off-hand drilling.

Gasket cutter illustrated in Fig. 3 is particularly useful when a number of gaskets are to be cut at the same time. Cutters are formed from drill rod; rough grind the cutting lips to shape, and file or machine the longitudinal flats before hardening and tempering. After drawing to temper, finish the cutting edges on a stone.

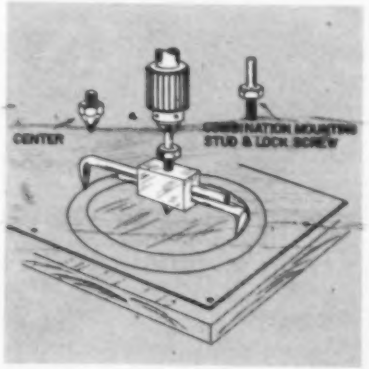
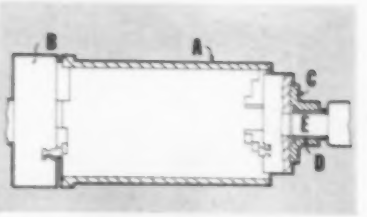


Fig. 3. Gasket cutter does fast, accurate job

Lay out holes in center block carefully and be sure drill for over-lapping holes is perfectly ground to eliminate drill wander during drilling.

Caution: Set drill press at slowest possible speed for this operation and be certain to clamp wooden cutting board firmly to drill press table.



Liner A is gripped in jaws of lathe headstock chuck B. Back plate C revolves on bronze sleeve D

New Tailstock Support

By F. E. RILEY

SOME LARGE cast iron cylinder liners with an over-all length of approximately 4 ft had been bored prior to honing, and the final operation was to turn the outside diameter to finished size. The bore diameter of 18-in was too large for use with the standard type of pipe center, so some other form of revolving support was required.

Final arrangement is illustrated in the sketch. The liner A is gripped in machined soft jaws of the lathe headstock chuck B and the right hand is centralized and supported by means of a standard 3-jaw self-centering chuck borrowed from another lathe. No modification to the chuck was required, other than the fitting of the new back plate C and truing up the outer ends of the chuck jaws where they made contact with the bore of the liner. The jaw tops were ground truly, with a ring gripped in one of the small-diameter outside steps.

Back plate C has a plain bore and revolves on a bronze sleeve D which is a push fit on the lathe tailstock barrel E and locked against rotation by means of a key which engages with the longitudinal keyway in the tailstock barrel. A rigid and accurate support for the overhanging work is offered by this economical arrangement.

This same device has been adopted for various other sizes of cylinder liners which are accommodated easily on the steps of the jaws chosen. A more rigid effect can be obtained if the bore through the chuck body is large enough to take the tailstock barrel and its bearing sleeve; thus overhang between jaws and backplate is eliminated.

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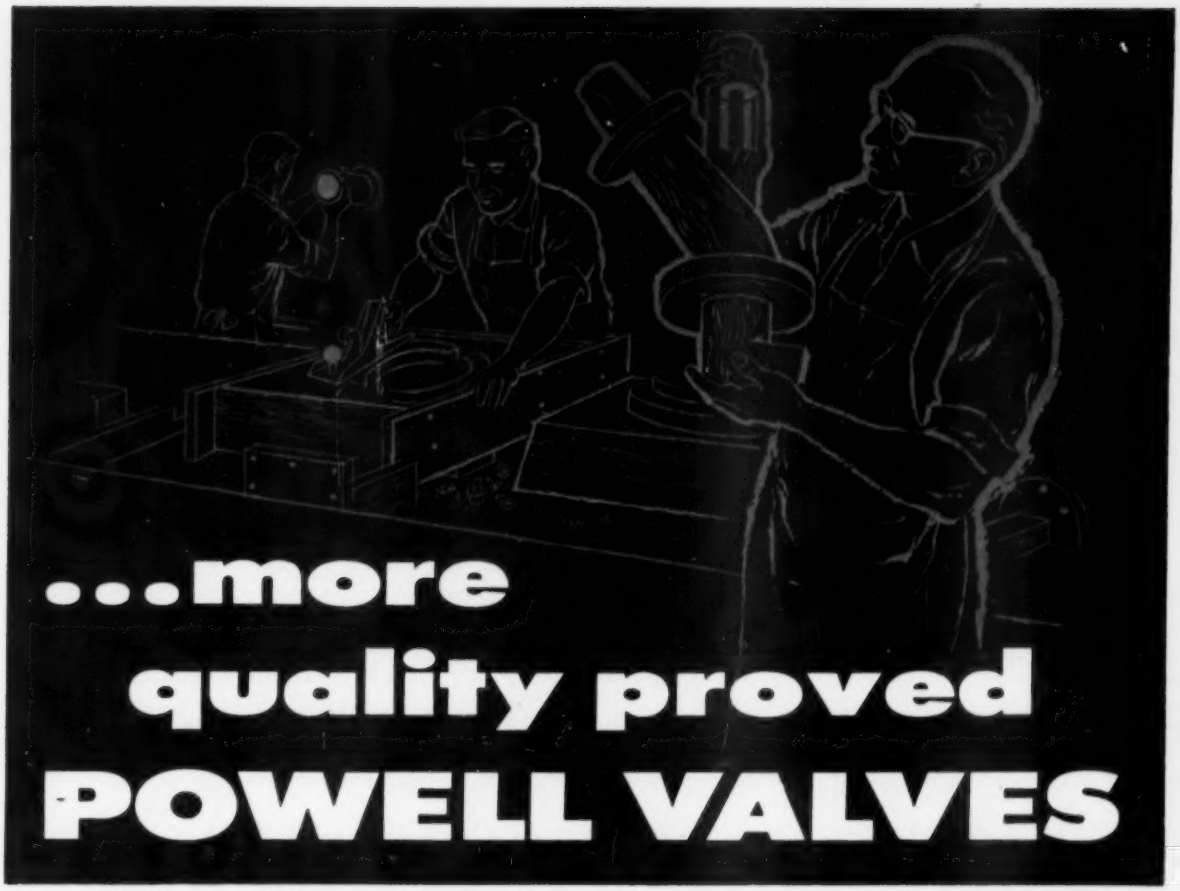

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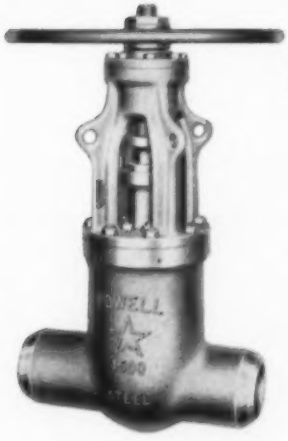


Fig. 11303—1500-Pound Cast Steel Pressure Seal Gate Valve.

Fig. 375—Bronze Gate Valve for 200 Pounds W.S.P. Union Bonnet. Inside Screw Rising Stem.

Fig. 11365—Steel Pressure Seal Horizontal Lift Check Valve for 1500 Pounds W.S.P.

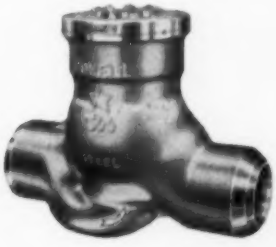
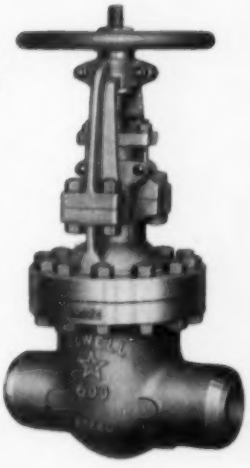


Fig. 6003-WE—Steel Gate Valve for 600 Pounds. Welding Ends. Outside Screw Rising Stem and Yoke.



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How To Figure Gravity Roof Venting

By JOHN D. CONSTANCE*

DESPITE THE MANY attributes of mechanical ventilation, many industrial buildings are still provided with gravity ventilation, using the natural forces of convention and the wind to ventilate their interiors. In this respect the two most important factors are temperature difference between the inside and the outside; and flow produced by the wind.

When considering temperatures only they are dependent on: 1. heat production in the building; 2. vertical distance between inlet and outlet openings; 3. the area of the inlets and outlets.

It is accepted practice for summer ventilation design to assume a temperature difference of 10 F degrees. The vertical distance above needs clarification and qualification.

Vendors of roof vents recommend using the clear vertical height between openings only when flow openings are of unequal area and resistance.

To compute the flow due to temperature difference, curves 1 and 2 in the accompanying graph may be used. Free flow curve 1 may be used when there are no obstructions in the air path. Curve 2 may be used when there is definite resistance such as hung ceiling with grilles leading to roof ventilators above in ridge or flat roof deck.

When size and resistance are factors, there has been developed the important concept of the neutral zone. If air will flow in at certain openings because atmospheric pressure is greater on the outside, and outward flow takes place at certain other openings because atmospheric pressure is less, there is a point of equal atmospheric pressure somewhere between, where the air will neither flow in nor out of an opening so located. This explains why high outflow and low inflow openings are more effective than openings situated near mid-height.

Location of the neutral zone varies with the size and resistance of the openings and its location is found somewhat in the same way as the center of gravity of a section. Prof. J. E. Emsweiler explains this method in a paper, "The Neutral Zone in Ventilation," published in the January 1926 issue of the *Journal of the American Society of Heating and Ventilating Engineers*. The determination is complicated and too time-consuming for the average installation. On the average it has been found adequate to use two-thirds of actual clear height for flow determination (see graph).

Opening areas are net after having been corrected by multiplying gross area by correction multiplier varying between 0.5 and 0.8. A good figure is 0.6.

Referring to the graph, curve 1 may be used to determine the unit flow rate per sq ft net area of either inflow or outflow openings, whichever is the smaller, when there is clear space and restrictions are negligible. If the condition of the outlets and inlets or the space between is not favorable, or flow is restricted, then curve 2 may be used. The unit flow so obtained from either curve represents that due to thermal head. For maximum efficiency of natural ventilation the height between openings should be as great as building construction will allow.

To thermal head flow we may add that due to wind effect, curve 3. A good conservative wind velocity to use is two miles per hour.

Once determining the additive unit figure of flow from thermal head and wind effect multiply this by net area of the smaller inlet or outlet openings and apply a correction factor where the ratio of inlet area to outlet areas is greater than unity. Note that the same applies to the ratio of outlet area to inlet. By examination it becomes apparent that there is no material increase in flow beyond the ration of 2.5.

Example: Free flow unit (H equals 27.5 ft) 180
Wind effect at 6 mph 186
Total unit flow 366
Net area 10.5 sq ft
Uncorrected flow rate (10.5) (366) = 3840 cfm
Area ratio is 2.5; factor is 1.315
Corrected flow rate (3840) (1.315) = 5050 cfm

Continued on page 88

*Consulting engineer, Cliffside Park, New Jersey.

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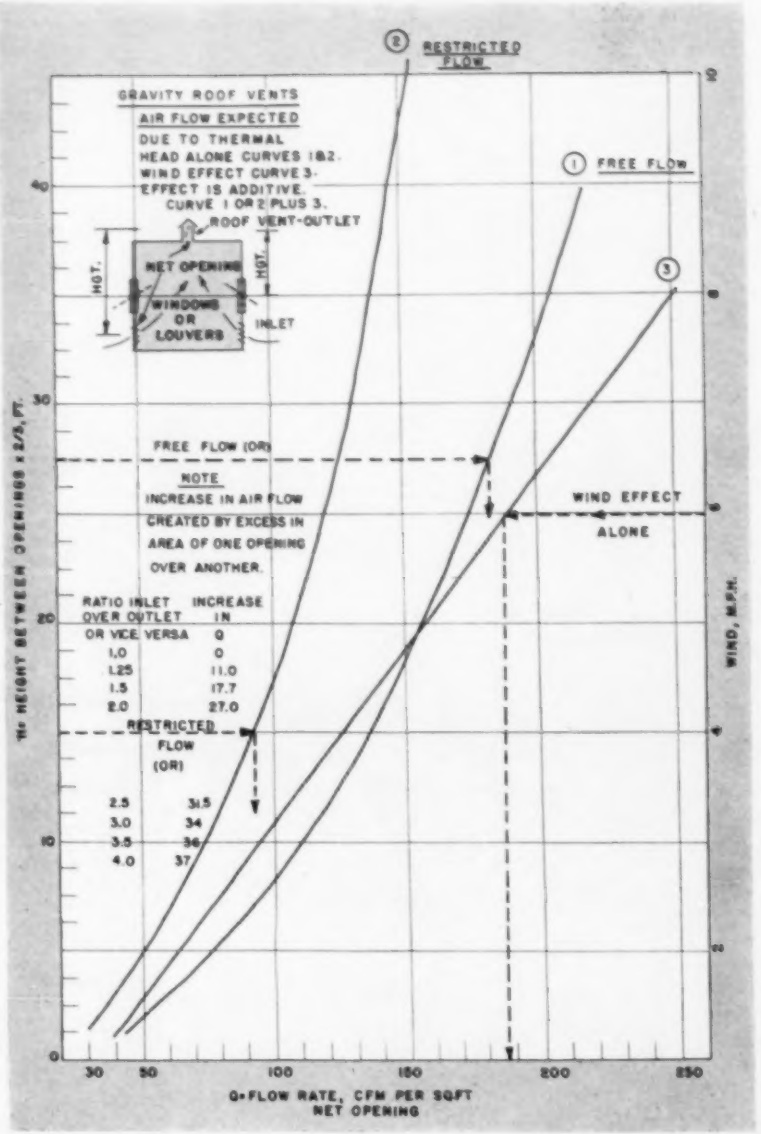

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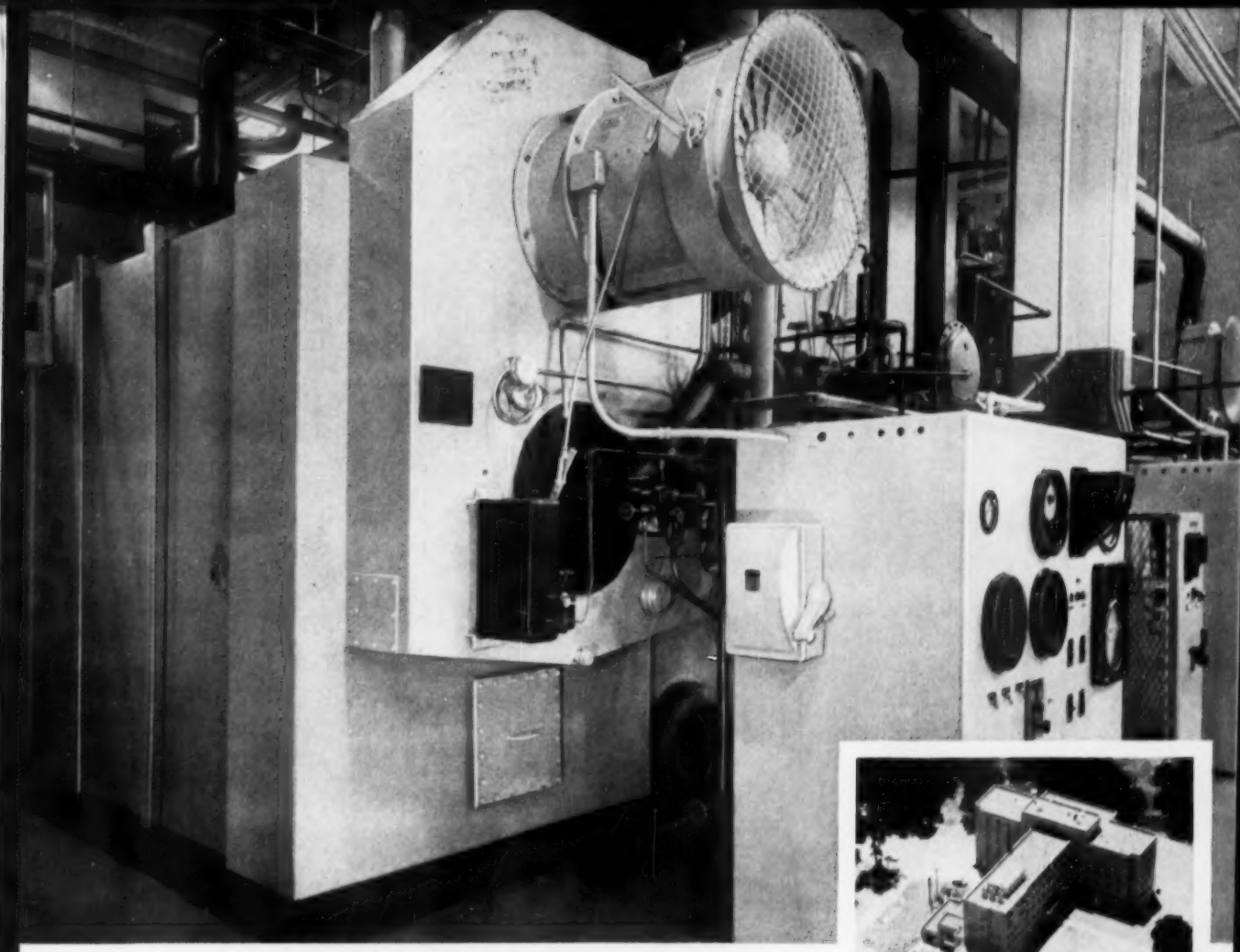

Dual unit installation of B&W Type FM Integral-Furnace Boilers at Barberton Citizens Hospital. Consulting Engineers: William E. Bodenstein and W. W. Shuster. Architects: Samuel Hannaford & Sons. Heating, Ventilating, Plumbing: T. O. Murphy Company.

Low Cost Steam Does Many Jobs

B&W 'PACKAGE' BOILERS SERVE BARBERTON CITIZENS HOSPITAL

Two B&W Type FM Integral-Furnace Boilers are the reliable source of plentiful, low cost steam that is put to many uses at Barberton Citizens Hospital, Barberton, Ohio. The gas-fired boilers, which can also use oil as a stand-by fuel, are automatically controlled to operate under minimum supervision.

Combined Capacity of the two units is 41,000 lbs of steam per hr, enough to supply an additional wing, should one be erected in the future. Both are "package" boilers, completely shop assembled. They only required service connections after installation.

The 250-Bed hospital, with a total of 560 rooms, uses steam for heating, sterilizers, a restaurant serving 37,000 meals a month, and a laundry that can handle 13½ pounds of linen per patient per day.

Long Life, low maintenance, reliability, continuity of operation, and efficiency have been proved for B&W Integral-Furnace Boilers in hundreds of installations in institutions and industry throughout the nation. They provide maximum capacity in small boiler room space, high fuel economy, and economical, fast steaming. They have built a reputation for quick response to wide load swings.

B&W Provides a single responsibility in design, engineering, manufacturing, installation, and service through a national network of plants and engineers. For detailed information on B&W Integral-Furnace Boilers, write for Bulletin G-76D. The Babcock & Wilcox Company, Boiler Division, Dept. AR-3, 161 East 42nd Street, New York 17, N. Y.

G-841-FM

BABCOCK & WILCOX

BOILER DIVISION

It is important to note that radiant heat from equipment, a common problem in boiler plants, cannot be controlled by general ventilation. It must first be converted to some other form by shields or cooling panels.

Some degree of comfort can be realized by spot cooling, i.e., by directing a high velocity air stream (200 to 400 fpm) on the workers. Even such blasts can have a heating effect under certain conditions of temperature and humidity.

Insulating the boiler casing or using reflective shields in addition to ventilation will help. Gravity vents will develop only low velocities (10 to 20 fmp).

New Way To Measure Condenser Air Leakage

RECENTLY a new method to determine condenser air leakage has been set up for unit No. 1 at River Rouge. It is more convenient to operate than the gasometer method now in use, and the operators can keep a closer check on the air leakage than before.

Method most commonly used to measure the air leakage is the gasometer. The gasometer measures a specified volume of the vapor. By measuring the time required to displace this specified volume, the rate of air leakage can be determined in cubic feet per minute.

New method (see sketch) uses an orifice, a manometer and a thermometer to measure the air leakage, as described by James H. Brennan in *Coal to Kilowatts*. The manometer measures the pressure drop across the orifice, the thermometer measures the vapor temperature, and the air leakage can be picked off a curve sheet conveniently located near the test set-up. The curve sheet has a family of temperature and orifice size curves. Knowing the manometer differential, the temperature, and the orifice size, the air leakage can be read directly from the curve sheet in cubic feet per minute.

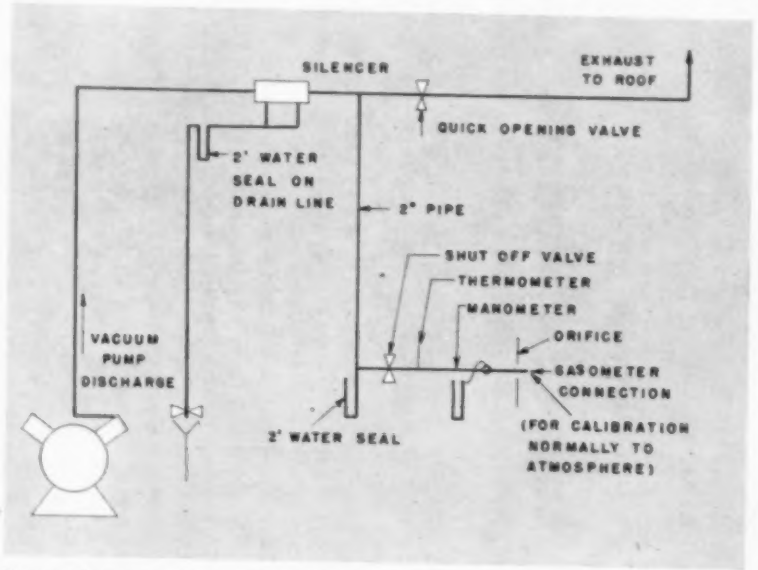

Diagram of connections for new orifice method of measuring air leakage. It keeps continuous check on leakage. Gasometer can be left in place to check new system. Connect gasometer by removing orifice

Advantages of the new method are:

1. It is more convenient to keep a regular check on condenser performance.
2. During a test, a constant air leakage can be obtained instead of an intermittent check.
3. By having the source connection for this set-up down-steam from the silencer, the pulsation caused by the vacuum pump is greatly reduced. This also serves to reduce the temperature. Normally the vacuum pump discharge temperature is in the range of 150 F. In the new location, the temperature is close to the room temperature.
4. This set-up also has a built in safety feature, that is, the 2-ft water seal (see sketch) which will protect the vacuum pump.

Soap and Graphite Save Pump Packing

PUMPS handling abrasive slurries frequently present a packing problem. The abrasive material gets into or through the packing that protects the bearings and either ruins the bearings or cuts the shaft sufficiently to destroy the sealing ability of the packing — and the latter leads inevitably to the former.

Lester Sagar, plant manager of the Dearborn Chemical Co, passes on this old-timer's trick of protecting these packings against the pernicious effects of abrasives in slurries. Mix, says Sagar, two parts of Lux flakes with one part of graphite, then add sufficient water to make a mixture the consistency of jelly. Saturate your pump packing with this compound before reassembling the unit and your packing problem ceases to be a problem.

We forgot to ask Les whether Ivory flakes would do as well as Lux flakes; we admit we don't know. Maybe Lux is kinder to glands as well as hands . . . or vice-versa. At any rate, this is a good trick and well worth trying if you are bothered by excessive packing wear in slurry pumps.

Workman using hand grinder especially developed for spark testing of steel, to check its grade

Simple, Easy Way To Do Spark Testing of Steel

SPARK TESTING of steel is a common method used in many steel warehouses, and large steel rooms of industrial manufacturers. By this method, much of the steel used today is graded and selected for further processing.

One of the easiest ways to do this is to use a hand grinder. It is easy to handle, light in weight and powerful enough to throw a sufficient spark stream to instantly establish the grade of steel tested. Compact size makes storage no problem. Or, it might also be used for other work, such as deburring, filing, smoothing weld seams, cleaning castings or for internal grinding.

The hand grinder used in the steel bin shown in the photograph is the Series 9, Dumore hand grinder. This handy tool was especially developed to handle such plant jobs as spark testing.

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Fuel cost survey proves coal best for Poinsett Hotel

The Poinsett Hotel, Greenville, S.C., recently decided to increase steam capacity by adding a new boiler in its power plant. At the time, management asked its consultants, The McPherson Company, of Greenville, to analyze costs of all three types of fuel available in that area. On the basis of cost per thousand pounds of steam, the other two fuels proved to cost 25% more than bituminous coal. According to The McPherson Company, "The net result of this study indicated that by continuing with the use of bituminous coal the owners would save on both the initial investment and on operating costs."

For additional case histories on burning coal the modern way or for technical advisory service, write to the address below.

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facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum • Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

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Standards for Direct-Fired Pulverized Coal Systems

FROM NATIONAL FIRE PROTECTION ASSOCIATION'S CODE 60A

DIRECT-FIRED system (i. e., unit system) for pulverized-coal is one in which the fuel is pulverized near the point of use in an air-swept pulverizer and delivered, suspended in the primary air, directly to the burner Systems of this type do not use pulverized-fuel bins. See Fig. 1.

A direct-fired circulating system (Fig. 2) is a form of direct firing in which one or more furnaces, with independently controlled burners, may be served by a single air-swept pulverizer, the burner pipes branching off from a loop header, and the surplus fuel and air being returned through the loop to some point ahead of the fan inlet.

Direct-fired systems may be arranged with the fan located either at the outlet or at the inlet of the pulverizer. The usual equipment includes: raw-coal feeder, air-swept pulverizer, exhauster or primary air fan, source of hot air (or flue gas), means for controlling temperature of air (or gas), piping and valves, and burners.

A No valves are required between the pulverizer and the burners for a single pulverizer connected to one or more burners in a furnace that cannot be fired by any other means, such as a stoker, oil or gas, provided that the combustion air to individual burners cannot be shut off (see Figs. 3-a, 3-b).

B. A barrier valve shall be installed between each exhauster or pulverizer and its burners for: (a) a suction furnace that can be fired by other fuels (Fig. 3-c); (b) a suction furnace connected to two or more pulverizers (Fig. 3-d). The provisions of C (below) are required if the system is designed for operation with one or more burners shut off.

Barrier valves shall be closed before an exhauster or pulverizer is opened for inspection or maintenance, as a protection against a furnace puff traveling back to the opened exhauster or pulverizer.

C. Dust-tight valve shall be installed in each burner pipe at the exhauster or pulverizer outlet for: (a) a pressure furnace, except as provided in A, above, see Figs. 3-b, 3-h and 3-i; (b) a suction furnace designed for operation with one or more pulverized-coal burners shut off (see Fig. 3-e).

Dust-tight valve is required if one or more pulverizers are connected to more than one furnace at a time (Fig. 3-f).

Dust-tight valve is not required in the case of spare pulverizers, which may be connected to any one of several furnaces when the regular pulverizer is disconnected, i.e., with a section of the discharge pipe between the exhauster or pulverizer and the furnace removed, and all the requirements of A, above, complied with.

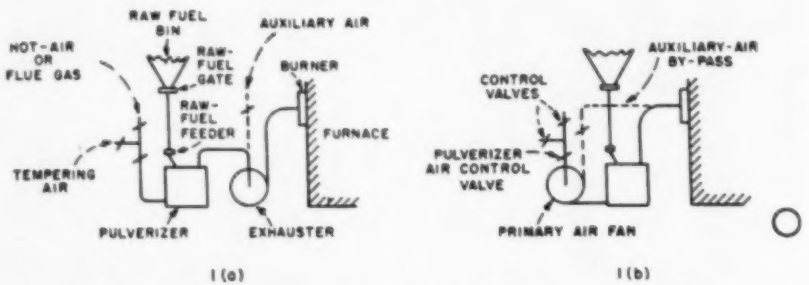

Fig. 1. Direct-fired unit systems. Pulverized-coal bins are not used, and problems of storage avoided

fold along this line—outside edges toward you

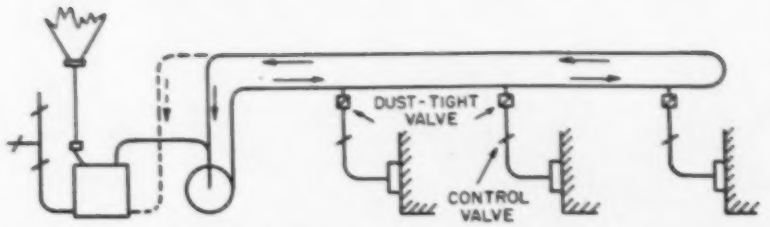

Fig. 2. Direct-fired circulating system looks like this. It may be served by a single air-swept pulverizer

Such valves shall be closed before an exhauster or pulverizer is opened for inspection or maintenance and on installations like Fig. 3-g, or locked shut or tagged with "hold-off" cards.

D. Dust-tight valves shall be installed in a portion of the pipe sloping upward steeper than 60 deg from the horizontal, and in such a way that dust accumulations under the valve will fall into the exhauster or pulverizer.

E. Dust-tight valves shall be installed in the burner piping when the discharge pipes from separate exhausters or pulverizers are connected to the same burner nozzle (Fig. 3-g). These valves shall be so interlocked that only one exhauster or pulverizer at a time can supply the burner nozzle, and shall be so arranged that the dust cannot accumulate in the idle burner piping.

Details on the arrangement and requirements for pulverized-coal *storage systems* are given in full in this same Code 60A published in 1956 by the National Fire Protection Association. This Code brings up to date standards which were first published in 1947.

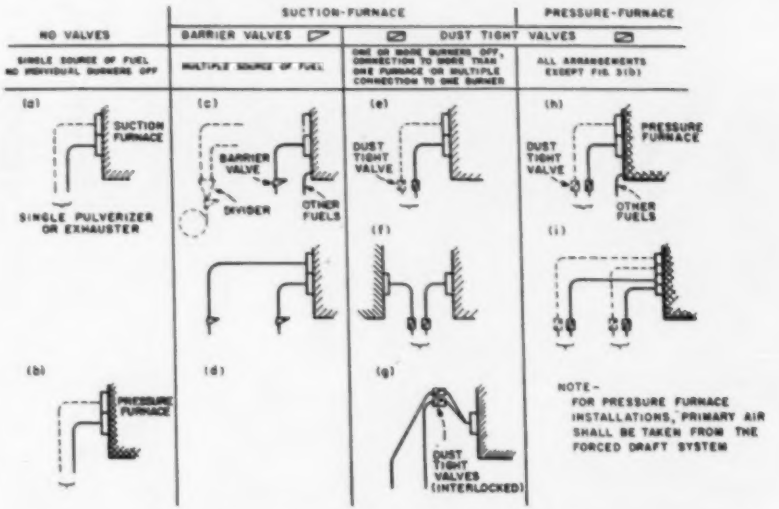

Fig. 3. Schematic guide to valve requirements in burner piping for direct-fired pulverized-coal systems

...cut along this line...

INSTALLING CONTRACTOR: O. A. WENDT COMPANY, CHICAGO

1300 FEET of trench were needed, without special preparation or forms. Note simple concrete supports—no anchors are evident.

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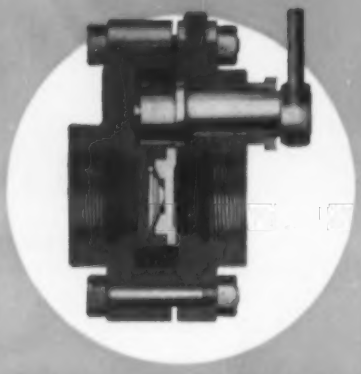

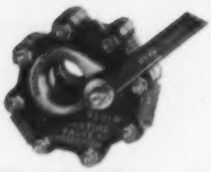

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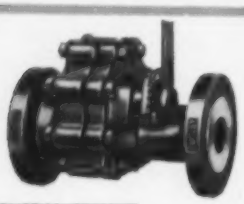

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What They Tell Us

continued from page 6

19 BWG ¾-in. dia arsenical admiralty tubes in steel tube sheets. Unit 1 tubes were Alclad (inside) 3003-H14, while on unit 2 some extra tubes were Alclad inside and outside and had a longitudinal welded seam.

Based on trials and study, it was then decided to use aluminum tubes exclusively in the condenser of unit 3. This 105,000-sq-ft condenser has 17 BWG 6061-T4 (previously 61S-T4) alloy tubes, this alloy being somewhat less in first cost and perhaps more resistant to corrosion than the alloys used in the trials.

As for cooling water: water from Lake Michigan is used at Oak Creek, which on analysis shows no constituents detrimental to aluminum. But with unfavorable water conditions, aluminum tubes should be used with caution and then only after considerable experimentation has been conducted. It would appear that aluminum tubes should not be used with alkali water or water containing heavy metals; and it would seem prudent not to use aluminum tubes where past experience has suggested extensive acid or chemical tube cleaning.

The question of electrolytic corrosion has not been a major problem at Oak Creek because steel tube sheets are used.

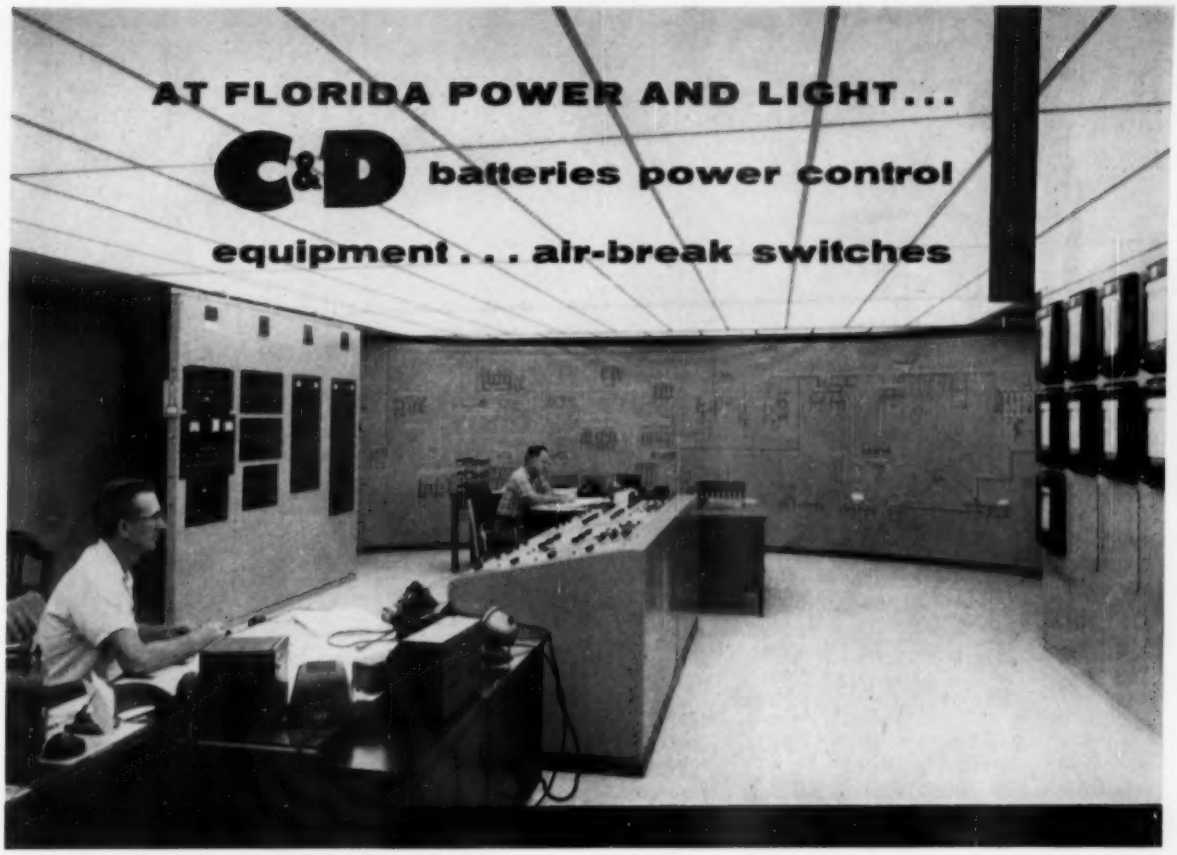
As for operating experience thus far at Oak Creek — inspections have all along been very critical of conditions. The steam side was provided with stainless steel shields in areas where units 1 and 2 had experienced erosion on admiralty tubes. In general, this protection has been adequate.

Several bottom row tubes were plugged due to steam side erosion. These tubes suffered impingement from condensate from an extraction header flashing as it entered the condenser. Inadequate baffling was the reason for this. Since baffling the condenser inlet, no further trouble has occurred.

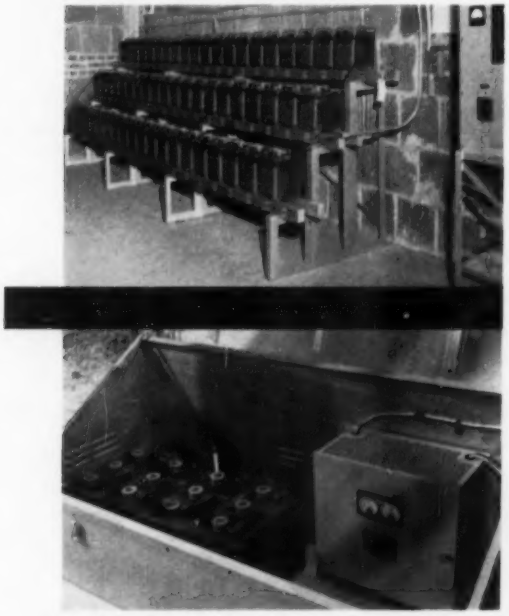
The water side erosion was minor, as anticipated. Dial gage measurements of many tubes showed very little, if any, loss of metal in the first seven months of operation. Less than 0.001-in. loss was the actual measured value.

Internal inspections of the boiler have revealed satisfactory conditions. Sludge accumulations have been small. No build-up has occurred in the controlled-circulation orifices.

Wisconsin Electric's conclusion is that aluminum tubes are satisfactory in condensers under the conditions at Oak Creek. Heat transfer characteristics for aluminum tubes are comparable to arsenical admiralty tubes; and the economics of aluminum tubes in steel tube sheets are favorable where other conditions warrant their consideration.



125-volt dc power to operate supervisory control equipment at Miami System Dispatching Office (above) is supplied by bank of C & D *PlastiCal*® Control Batteries (below). Long-life lead-calcium plate batteries have 160 ampere-hour capacity (at 8-hr. rate).



24-volt application of C & D *PlastiCal* Batteries for dc control of motor-operated air-break switches used in automatic load transfer switching. Located in the field, batteries require practically no attention. Other C & D 24-volt batteries supply power for carrier current trip blocking transmitters used in transmission relaying.

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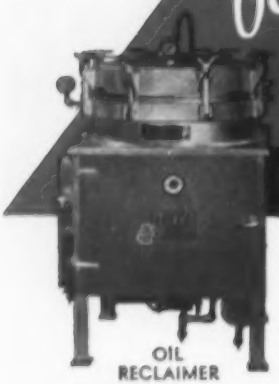

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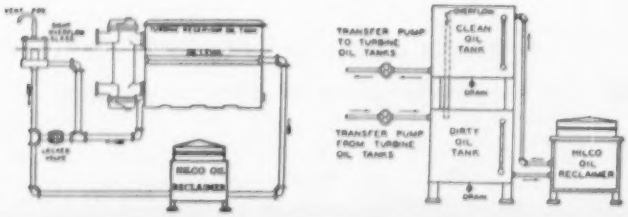
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Turbine Seals

continued from page 79

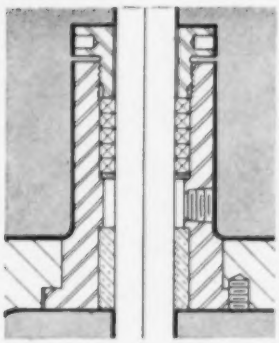

Fig. 6. Bushing and flexible metal packing are used to prevent leakage at valve stems

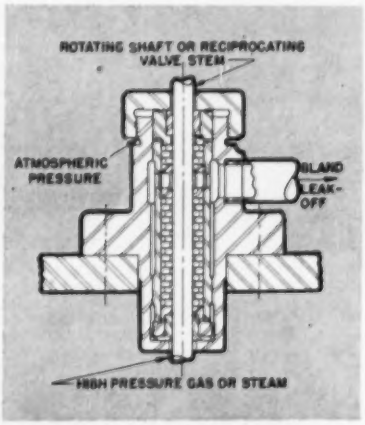

Fig. 7. Multiple bushing or floating ring seal assembly for pressures and temperatures over 850 psig and 1000 F

bushing (Fig. 6 above) and the outer gland leads the leakage steam to a low-pressure stage of the turbine to reduce the pressure on the packing gland. For moderately high pressure and temperature, the flexible metallic packing is eliminated with the addition of two more bushings and another bleed-off at the steam-seal system.

However, pressures and temperatures over 850 psig and 1000 F may cause distortion and make it difficult to keep the three bushings properly aligned with the small clearances needed to keep the leakage down to a minimum. To overcome this situation, a seal manufacturer has developed a very effective seal, shown in Fig. 7, which consists of concentric floating rings that have, alternately, close and large clearances with the shaft and housing.

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Philo Does It Again

Continued from page 62

no formation of steam bubbles; the densities of steam and water are the same. Water enters one section of the unit's tubes and steam discharges from the other end. This unit is fired with coal by three Cyclone furnaces.

In such a unit, it is vital to prevent deposits in the steam generator's tubes and in the steam turbine, and also to prevent corrosion. Accordingly, a demineralizing system prepares the make-up water with a purity of less than 500 ppb (parts per billion) of dissolved solids, and silica less than 20 ppb, while other treatments hold iron oxide to less than 10 ppb and the pH is held at 9.5.

Boiler feed pumps consist of a low-pressure booster pump and a high-pressure feed pump, connected to the opposite ends of the shaft of a 3550-rpm, 4000-hp electric motor. The l-p pump is direct-connected and, taking suction from the deaerator, raises the feed water pressure to 2100 psia. The h-p pump is driven through a fluid-drive coupling at 6500 rpm and raises the feedwater pressure from 2100 to 5450 psia for introduction into the steam generator. It takes 2½ min for an element of water to pass through the generator.

As can be seen, control for such a steam generator and steam turbine involve entirely new concepts. These are detailed in Fiala's paper noted above.

Electrical generation is by a conventional 13,500-v hydrogen-cooled, 150,000-kva generator, Fig. 6, with shaft-driven exciter. This unit delivers power to the existing 132-kv buses at the station. Incidentally, in connection with the new unit, samples of the aluminum conductors used in the AG&E's 345-kv transmission system were displayed.

E. L. Seidler is now plant manager at Philo Plant. He and A. N. Prentice, vice-president and general manager of Ohio Power Co, and A. G. Lloyd, engineer in charge of installation, explained its fundamental principles and construction at the preview.

What does Philo Unit No. 6 mean? Philip Sporn, answering this question, said it means: 1: that while waiting for atomic power to mature commercially, the power industry must continue to progress technically; 2: that the industry must meet the challenge of both the country's expanding demands and of its progressive younger men; 3: that it shows the way to further advances in the art. The development of Philo No. 6, he said, has led to designs for two new supercritical units, each of 450,000-kw capacity, to have vertical-type once-through supercritical steam generators, and to be erected at about 30 per cent lower initial investment than if built by present known methods.

In short, besides showing the way to further economies in generation, the Philo project demonstrates the dynamic character of the electric power industry. It breaks through the barriers of capital cost and operating cost, with the objective of reducing power costs to the consumer. Without this all-pervasive electric power industry, our society could not function as it does.

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201 Water Tube Boilers — This 12-pp catalog describes packaged water tube boilers, in capacities from 8000 to 50,000 lb per hour. Interesting as well as informative, this booklet uses color and illustrations to amplify text. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

202 Shop Assembled Boiler — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM watertube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. The Babcock & Wilcox Co.

203 Hot Water Boilers — This 20-pp brochure describes and illustrates design, construction, advantages and economies of the C-E La Mont controlled circulation hot water boiler for supplying high pressure, high temperature water for heating systems and process applications. Combustion Engineering, Inc.

204 Automatic Boilers — Bulletin BE-4 describes operation and advantages of Continental automatic boiler's spinning gas technique — a method of obtaining maximum heat transfer with a simplified design. Shows cutaway view of boiler construction; illustrates hinged doors and method of injecting air. Boiler Engineering & Supply Co., Inc.

205 Steam Generators — Bulletin 55-1, 22-pp, describes company's products and services, including not only steam generators but also custom metal fabrication. There are many photos of boilers in various stages of assembly. Engineering drawings of boilers producing up to 500,000 lb of steam per hr on standard fuels are included, as well as illustrations of units for waste heat application and those designed to utilize refuse for fuels — wood chips, coffee grounds. The Wickes Boiler Co.

206 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-type boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie City Iron Works.

207 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data and dimensions for the units. Preferred Utilities Mfg. Corp.

208 Standard Generators — Bulletin B-55-4 describes company's SC econ-

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209 Packaged Generators — Bulletin MH 3-54, 14-pp, gives detailed coverage to company's Type MH packaged water tube steam generators which are furnished for oil or gas firing or both, with automatic, semi-automatic, or manual controls. Included are: cutaway illustrations, installation photos, tube arrangement layouts, construction details, auxiliary equipment, dimensions. Union Iron Works.

REFRACTORIES, INSULATIONS

210 Refractory Concrete — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Universal Atlas Cement Co.

211 Refractory Cement — Heavy duty brick bonding and patching mortar is described in this 8-pp illustrated color folder. Includes success stories concerning the product's application in high temperature work and in the protection of equipment against slag, fly ash and gases. Refractory and Insulation Corp.

212 Refractory Castable — Bulletin R-40 describes use of Kaocrete-32, a high temperature refractory castable, in boiler ashpits. A discussion of various methods of ash removal, along with maintenance problems peculiar to each, is presented. Four typical installations are detailed. Refractories Div., The Babcock & Wilcox Co.

213 Insulations, Refractories — This 20-pp catalog features thermal insulations and refractories for general industrial applications. Organized for quick reference, catalog provides information on composition, physical and thermal properties and sizes of the various products. Lists chief advantages, covers materials for efficient control of temperatures from — 400 F to 3000 F. Johns-Manville.

214 Underground Pipe Insulation — This illustrated bulletin discusses the problems of underground pipe insulation and explains how company's insulation for hot underground pipes overcomes them. On-the-job photos illustrate ease of application; brief technical data are also included. American Gilsonite Co.

215 Duct Insulation — Engineering data and application instructions for company's semi-rigid, spun mineral wool duct insulation are presented in this informative bulletin. Thermal and sound absorption characteristics are presented in tabular form and physical, chemical, mechanical properties given. Baldwin-Hill Co.

FUEL BURNING EQUIPMENT

217 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and

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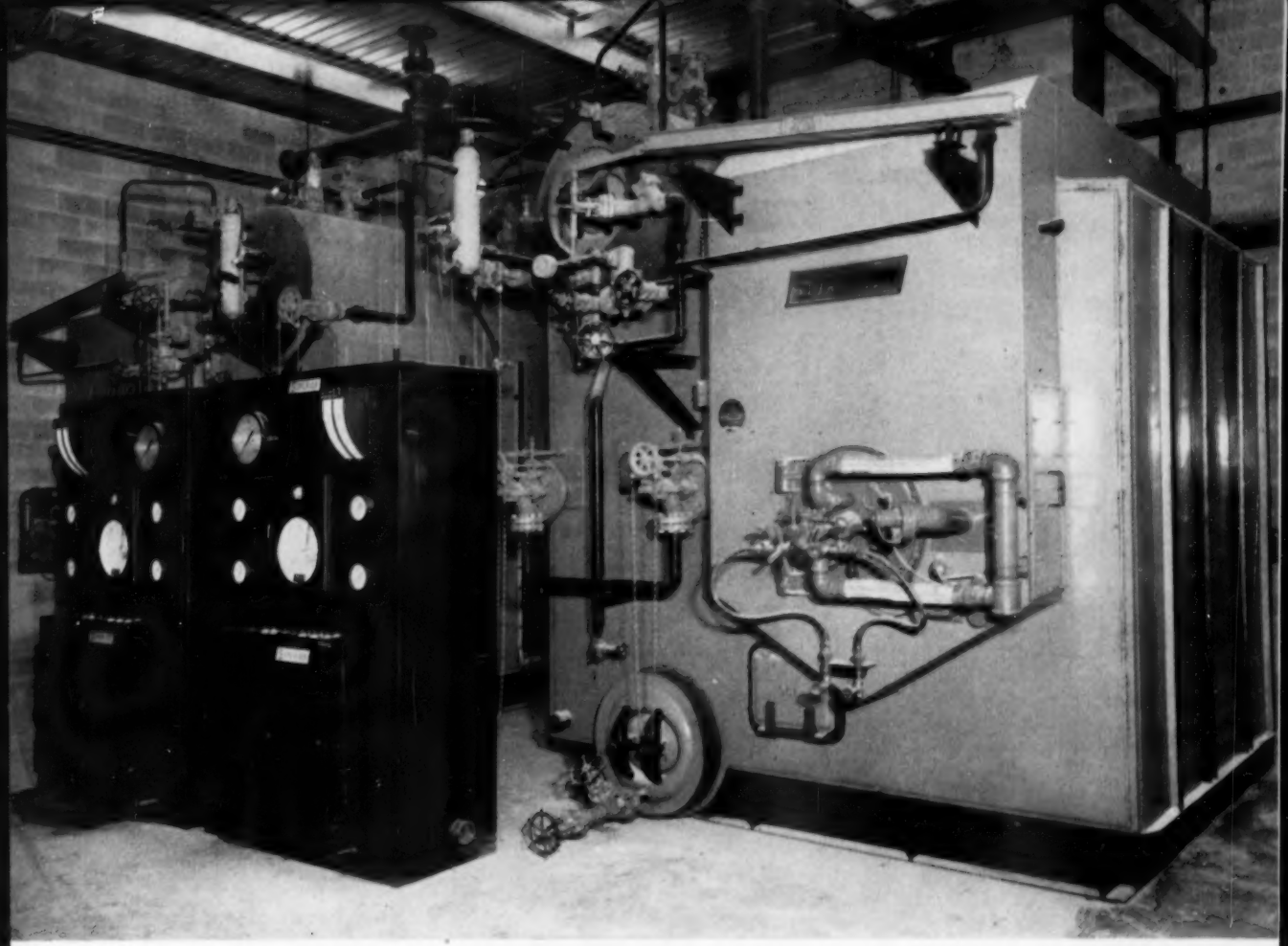

Complete factory fire testing assures top performance for these SUPERIOR *Steam Generators*

Photo above shows two 10,000 lb. per hr. Superior Steam Generators being installed at Central Fibre Products Co. Omaha, Nebraska.

Complementing the simplified installation which packaged design provides, is the ease of initial starting and firing on the job assured by factory fire testing of every Superior Steam Generator.

Standard procedure on every boiler built by Superior Combustion Industries, Inc. is factory fire testing. It provides for a check on functional performance and allows trained factory personnel to make whatever adjustments are necessary to bring the units into top operating condition in the shortest possible time. Whatever your boiler requirements, make factory fire testing part of your specifications. It's your best assurance of the maximum performance which the unit can provide.

Superior Steam Generators are built in water tube models for capacities from 8,000 to 50,000 lbs. per hour, burning oil or gas. Standard design pressures are 250, 300, 450, 600 and 900 psig.

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Specialists in PACKAGED BOILERS... exclusively

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
STEAM GENERATORS

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New trends in the use of refractories

Laclede Thintite Tile construction for water wall backing and boiler baffles.

Reduce costs, speed up installation with interlocking Laclede Thintite Tile

Interlocking Laclede Thintite Tile offers *exclusive* advantages for water wall backing, as well as for boiler baffles and roof coverings. Tile sections interlock quickly and easily, reducing installation time and lowering cost per square foot. This interlocking design keeps the wall tightly sealed—reduces leakage to a minimum. Also, the Thintite wall is completely uniform—free from deformation or warpage.

Light weight Thintite Tile is machine-made of first quality fire clay to a single shape. The single shape permits use of Thintite for walls, baffles and roofs, thus reducing inventory requirements.

Call your Laclede-Christy representative for all the facts. *Refractories Division, H. K. Porter Company, Inc., St. Louis 10, Missouri.*

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wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

218 For Burning Refuse Fuel — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuels such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses construction features of various components. Riley Stoker Corp.

219 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

TUBING AND ACCESSORIES

220 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

221 Heat Exchanger Tubing — Cited in this 30-pp catalog are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions, as to pollution, excessive turbulence, temperature and the like, required such tubing. The International Nickel Co., Inc.

222 Life Extension for Condenser Tubes — The 32-pp current edition of this booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in others. Revere Copper and Brass, Inc.

223 Tube Expanders — Catalog 88, 119-pp, is full of detailed information about tube expanders and associated tools used for tube rolling. Profusely illustrated, catalog provides information relative to boilers, condensers, evaporators or miscellaneous heat exchangers. Special sections are devoted to expanders, accessories, measuring instruments, rollers, extensions and drives. Each type of equipment is fully described, applications are listed, and tables of engineering data included. Also covers tube expansion methods, tool maintenance, expansion calculations and charts giving sizes. Thomas C. Wilson, Inc.

VALVES, TRAPS, PIPING AND ACCESSORIES

224 General Purpose Valves — Supplement No. 1 to Catalog F-9, 32-pp, offers complete information on company's series of general purpose drop forged steel valves, gate, globe and angle types, sizes ¼ through 2 in. Includes descriptions of each type along with drawings showing component parts. Dimensions and other specifications are tabulated, and a pressure-temperature ratings table is included. Henry Vogt Machine Co.

Unretouched photo showing typical return line corrosive action resulting from carbonic acid and dissolved oxygen in condensate.

BREAKING DOWN WITHIN

This section of pipe looks like new—on the outside. But take a look inside. Grooving action caused by carbonic acid and deep pitting, the result of dissolved oxygen attack, have almost completely penetrated the pipe wall.

Dearborn FILMEEN* prevents such destruction. FILMEEN forms a protective, non-wettable barrier between treated steam, or condensate, and metal pipe surfaces. By preventing the carbonic acid and dissolved oxygen from coming into contact with the metal, FILMEEN assures corrosion-free lines. FILMEEN is only one of many Dearborn water conditioning products scientifically developed to control specific corrosion problems. Others eliminate scale, sludge, carry-over and similar difficulties.

Power engineers in leading industrial and commercial plants place their confidence in Dearborn's 70 years of experience in water chemistry. They have found the answer to the demand for complete plant protection in Dearborn Supervisory Service—a properly balanced water conditioning program which combines quality products with correct, technically supervised control methods and test procedures.

Let a Dearborn Engineer survey your plant and recommend the type of water control program best suited to your requirements.

**FILMEEN is the trade-mark of a corrosion-inhibiting compound patented and produced exclusively by Dearborn Chemical Company. U.S. Pat. No. RE 23614.*

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Gentlemen: ☐ Have a Dearborn Water Conditioning Engineer call.
☐ Send me complete information on Dearborn Water Conditioning Program.

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Company.....
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City.....*Zone*.....*State*.....

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MAKE YOUR POWER PLANT AND ENGINE ROOM

run Smoother

CONCO GUN AND CLEANING PLUGS

The Conco Gun and Cleaning Plugs economically keep steam condenser and heat exchanger tubes clean. They are typical of the many Conseco Specialty Items that guarantee economical, efficient Power Plant and Engine Room operation.

The famous Flowrites combat erosion at tube inlets. Fibre Plugs plug leaky tubes without any danger of air leakage through the material.

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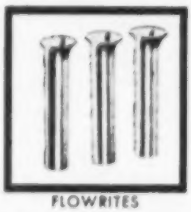
Get complete details of all Conseco Specialty Items for smoother, more efficient operation.



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BEVEL GEARS

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CONDENSER SERVICE & ENGINEERING CO., INC.

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

158 OBSERVER HIGHWAY
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to increase efficiency and cut power costs

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CONSECO DESIGNS AND BUILDS

HEAT EXCHANGERS • CONDENSERS • FEED WATER HEATERS • PRESSURE VESSELS • EVAPORATORS • STEAM JET AIR EJECTORS • FILTERS AND STRAINERS INSTRUMENTS • SEWAGE EJECTORS • CONDENSATE COOLERS • SPECIALTY ITEMS • ENGINE PARTS • SERVICE WATER COOLERS

Descriptive Bulletins Sent Promptly

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225 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

226 Diaphragm Motor Valve — Bulletin J-170 describes outstanding features of company's diaphragm motor valve designed for accurate control of pressure, temperature, rate of flow, and liquid level. Cutaway view showing component parts is included, along with data on materials of construction, capacity tables, and flow diagram. The Jordan Corp.

227 Regulating Valves — Bulletin 5305 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured-body engineered for high capacity at low pressure drop. Leslie Co.

228 Industrial Valves — Condensed Catalog 105, 28 pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Also included is company's Mudwonder valve for abrasive fluids. Edward Valves, Inc.

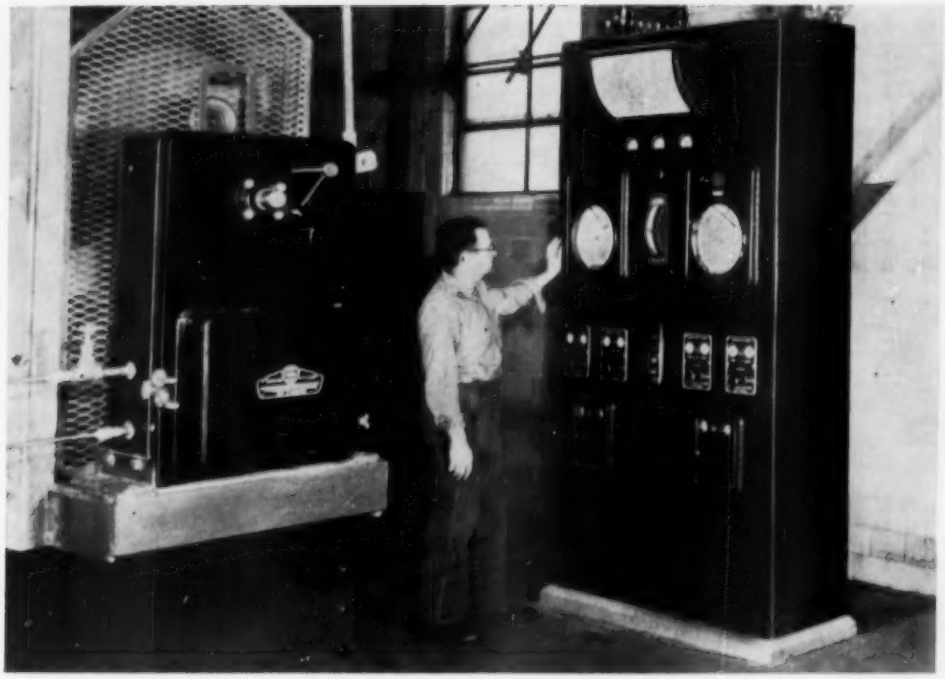
229 Water Hammer Control — Cause, effect and control of water hammer in piping systems is the subject of 8-pp Bulletin WH 851. Photos, drawings and curves supplement text, and test data is presented to show efficiency of company's silent check valves in water hammer control. Some typical installations are illustrated. The Williams Gauge Co., Inc.

230 Boiler Blow Off Valves — Bulletin E-125, 24 pp, describes and illustrates the design and construction of company's quick-operating valves, angle valves, Y valves and duplex units specifically designed for boiler blow-off service. Includes dimensions. Everlasting Valve Co.

231 Lubricated Plug Valves — Catalog PV-24, 36-pp, shows in detail a line of iron and steel lubricated plug valves. Many illustrations of the single, screwed and bolted gland type valves are shown, including photos, sectional and detailed drawings. Also included is physical data on dimensions. The Wm. Powell Co.

232 Valve Chart — Form 194R, 22 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

233 Bronze and Steel Valves — Catalog 200, 80 pp, describes company's bronze and steel valves, including globe, angle, gate, Flocontrol and other types applicable to power, petroluem, chemical and general industry installations. Engineering data such as material specifications, flow charts, temperature and pressure ratings are included. The catalog is profusely illustrated with photos, cutaway views and dimensional drawings. Manning, Maxwell & Moore, Inc.



This Bailey Control System helps cut fuel costs on a 70,000 lb per hr capacity 125 psi boiler in an industrial plant. Control drive in foreground regulates stoker.

How Bailey stretches your fuel dollar...

You can wring more energy out of a dollar's worth of fuel when you are getting optimum performance from your steam plant equipment. You get peak performance when Bailey Meters and Controls are on the job. They increase your plant efficiency.

Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

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There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering control on your steam plant control problems.

A132-1

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Globe type for 3" to 24" lines.

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Surge pressures . . . and resulting water hammer . . . are effectively controlled by these valves. They close instantly whenever flow reversal starts, or when flow is zero—providing dependable protection for piping, pumps and other components in air conditioning systems.

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No. 851 on Cause, Effect and Control of Water Hammer

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234 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are discussed and illustrated. Crane Co.

235 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, as well as repair. Armstrong Machine Works.

236 Steam Trap Selector — Twelve-pp Bulletin T-9 is designed specifically to aid in selection and application of steam traps on chemical processing equipment. Features a foldout piping diagram for 22 pieces of typical processing equipment — each showing recommended steam trap and piping arrangements. Also contains selector tables. Yarnall-Waring Co.

237 To Get at Those Valves — This little folder describes a sprocker rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

PACKINGS, SEALS

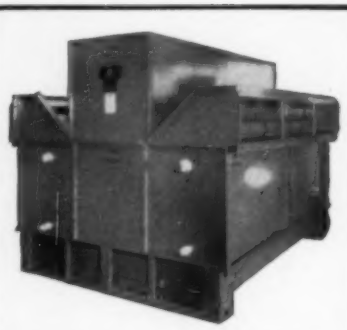
238 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing applications. Packing Div., Raybestos-Manhattan, Inc.

239 Mechanical Packings — Featured in 24-pp Catalog 56 are several recent packing developments including the multi-purpose Bel-Vee V-Ring packings, the long wearing criss-cross Braid packing series, twisted foil packings for oil and distillate temperatures to 1000 F, and an Inconel-wire reinforced plastic packing for valves handling superheated steam at temperatures up to 800 C. Packings for every industrial application are covered and a recommendation chart is included. The Belmont Packing & Rubber Co.

PUMPS AND PUMPING

240 Controlled Volume Pumps — Bulletin 953, 24 pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water treating systems are presented through text and diagrams; and an anlysis of boiler water treating systems, cooling water treating problems, and systems for waste and sanitary water treatment included. Milton Roy Co.

241 For Abusive Pumping Jobs — Catalog 4906, 36 pp, covers centrifugal pumps for wide industrial use and especially adapted to handling ashes, abrasive mixtures, slurries, hot and corrosive liquids. It describes several basic types: a



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- **Because the new design improves the heat transfer to the out-door air by evaporation.**
- **Because new features keep your equipment working for long life with "new plant" efficiency . . . always full capacity.**
- **Because you save 95% of cooling water cost.**

You get faster, more accurate cooling of industrial fluids to specified temperatures.

You improve your quality of production by removing heat at the rate of input.

You save labor in upkeep. With full access to all interior parts and piping you see everything in easy inspections. You head off dirt accumulation and corrosion. Casing panels are removable without moving the coils. The coils can be cleaned from both sides.

First cost is low; freight is low because of the lowest space/weight ratio; you save much labor in erection. Capacity range is 7,000,000 to 18,000,000 Btu/hr. No other heat exchange method gives you so much saving in money and convenience.

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District Engineers in Principal Cities of U. S. and Canada

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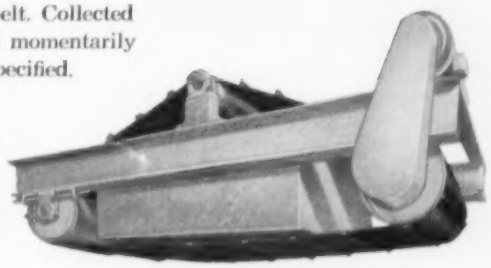
clean coal at high speed —*magnetically*

STEARNS

SUSPENDED SEPARATION MAGNETS

Even at conveyor speeds of 600 fpm and faster, you can remove dangerous tramp iron efficiently with a Stearns suspended separation magnet. Installed in a coal handling system, the powerful electromagnetic assembly creates a deep, penetrating magnetic field that blankets the entire width and depth of the conveyor burden, removes tramp iron before it can damage expensive coal pulverizing equipment or boiler feeders. 48

Stearns rectangular suspended magnet may be installed at the conveyor head pulley, in the position shown, or anywhere along the belt. Collected tramp iron is discharged by moving the magnet aside and momentarily shutting off current. Chain or wire rope suspension may be specified.



Stearns cross-belt suspended separator provides completely automatic tramp iron removal. A cleated belt moving across the face of the standard rectangular magnet (same as above), at right angles to the coal conveyor, carries tramp iron to one side, discharges it into a chute or receptacle.

Stearns magnet specialists, backed by 40 years of research and engineering experience, design and build rectangular or circular-suspended magnets, permanent or electromagnetic pulleys in a wide range of standard sizes — or to any specifications to meet your requirements. Get complete details from your Stearns representative — or write for Bulletin 1031-M.

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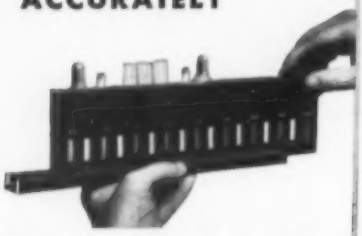
To Inhibit Scaling and Corrosion

TAYLOR COMPARATORS

HELP YOU ADJUST

pH, PHOSPHATE LEVELS

QUICKLY, ACCURATELY



By making fast, on-the-spot determinations for pH, phosphate, nitrate or silica with handy, portable Taylor Comparators, you can easily maintain proper control of boiler, condenser or cooling tower operations. In a matter of minutes you get accurate, dependable data from easy, colorimetric tests. Only three simple steps . . . fill three tubes with sample, add reagent to center tube and read result direct from slide after matching colors. Complete instructions, all necessary accessories and reagents included in every set.

WATER HARDNESS may be determined easily, yet with accuracy of an alkalinity titration, with the Taylor Total Hardness Set.

COLOR STANDARDS GUARANTEED

Be sure to use only Taylor reagents and accessories with Taylor Comparators to assure accurate results. All Taylor liquid color standards carry an unlimited guarantee against fading.

SEE YOUR DEALER for Taylor sets or immediate replacement of supplies. Write direct for FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes full Taylor line.

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horizontal shaft, single-stage side suction pump; a horizontal shaft, single-stage, rear-entrance automatic priming pump; vertical shaft pumps with standard, overhead and quill bearings for wet pit applications. Nagle Pumps.

242 Steam Pump Care — Bulletin G-2280, "How to Install and Take Care of Steam Pumps," is a 24-pp booklet containing a step-by-step series of 88 illustrations showing how to increase the service life of all types of steam pumps. It offers 28 tips on proper installation of the pumps, 54 tips on care techniques. Section on installation provides information on suction, packing the pump, starting it, and trouble shooting. Section on maintenance deals with such subjects as steam valves, liquid piston and rod, piston packing, liners. Worthington Corp.

INSTRUMENTS, CONTROLS

243 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater. Copes-Vulcan Div., Blaw-Knox Co.

244 Instrument Panels — Power and process plants can choose instrument and control panels to meet individual specifications from six standard designs described in 16-pp Product Specification G71-7. Complete specifications are furnished, as well as information on supports and mountings for tubes, wires and equipment, instrument mounting dimensions, and dimensions of standard instrument and control panels. Bailey Meter Co.

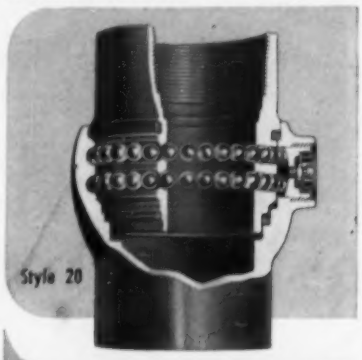
245 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

Postage-free cards for ordering catalogs are on page 98. You may also use the cards to order literature mentioned in the ads.

246 Control Fundamentals — Three important factors in combustion control — safety, efficiency and long life — are considered in detail in 16-pp Form EB-1-756, the first of a series. Reviews basic concepts involved in automation in combustion, or the provision of automatic means for sensing heat requirements to assure correct proportioning of fuel and air under optimum conditions. Fundamentals of controls common to all systems are covered. Cleveland Fuel Equipment Co.

247 Solenoid Pilots — Several types of solenoid pilots for use with company's regulating valves are described in Form 1010. Lists reasons for economies in on-off control, describes applications, and gives type of pilot, material of construction, maximum pressure and maximum temper-

SWING YOUR PRODUCTS INTO LINE



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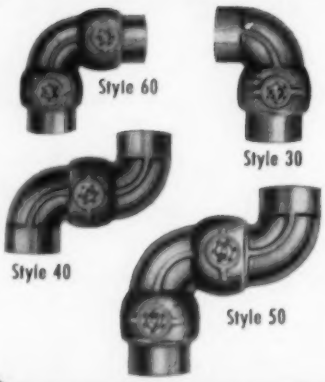
SWING EASY! FLOW EASY!



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FULL UNRESTRICTED FLOW • EFFORTLESS MOVEMENT • GREATER LOAD CARRYING CAPACITY • "O" RING SEALED CONTAMINATION FREE OPERATION • PERFECT ALIGNMENT

The wide range of sizes and styles of OPW BALL BEARING SWING JOINTS offers many and varied applications for safely handling liquids of diversified viscosity at required temperatures and working pressures.

Free Catalog F-8 provides engineering data, sizes, styles and recommendations.

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ature for two- and three-way pilots in steam, gas and liquid service. Schematic diagrams of typical applications are given. Spence Engineering Co., Inc.

248 Resistance Temperature Detectors — In 8-pp Publication 3016D are described a line of remote temperature-sensitive elements for use in indicating, recording, controlling and monitoring equipment. Operation, application and construction details of the resistance temperature detectors are presented, along with specifications and ordering tips. Instrument Div., Thomas A. Edison, Inc.

MECHANICAL POWER TRANSMISSION

249 Speed Reducers — Design and operation advantages of company's line of Torque-Arm speed reducers are outlined in 28-pp Bulletin A-637. Includes selection tables for double and single reduction units, bore dimensions and bushings, data on overload releases, flange mounted speed reducers, and recommended V-belt drives. Dodge Mfg. Corp.

250 V-S Drive Selection Tips — Bulletin 20P50, 44 pp, carries handy multicolor tables for quick and easy selection of variable speed Texrope drives. In addition to providing these tables for A, B, C and D section variable speed drives, booklet includes information on design features, drive principles, horsepower rating tables, speed range table. Allis-Chalmers Mfg. Co.

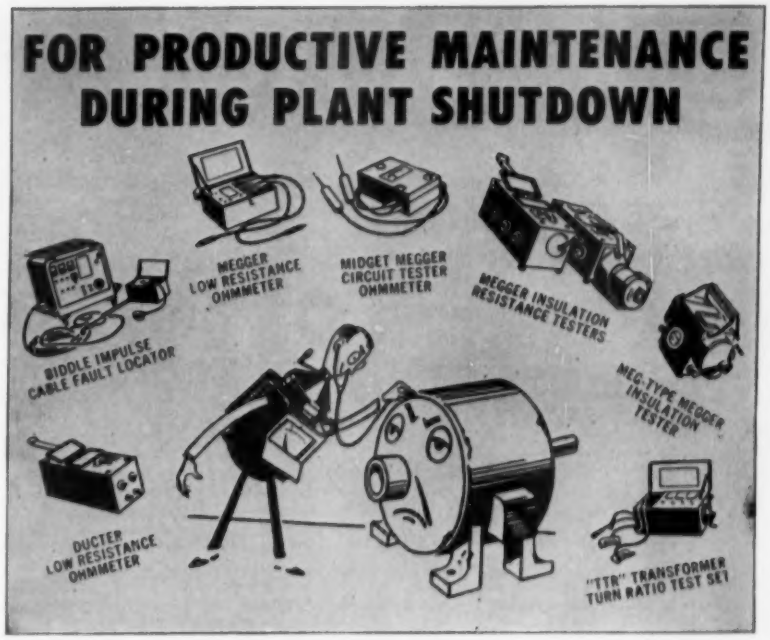
251 Internally Geared Power — Featuring latest design improvements in gearmotors and embodying 60 multicolor illustrations, 16-pp Form F-1880 shows comparative advantages of gearmotors, lists ratings from ½ to 30 hp with gear ratios as high as 10:1. Cross-sectional details and enlargements of outstanding features are included, as well as a discussion of use of elliptoidal helical gears, and a chart graphing degrees of tempering of gear teeth. U. S. Electrical Motors Inc.

ELECTRICAL EQUIPMENT

252 Testing Instruments — Bulletin 19-57, 16 pp, features company's electrical testing instruments, including ohmmeters, ground testers, dielectric test sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos and descriptions of each type, including chief features, operating ranges, and applications. James G. Biddle Co.

253 On Copper Conductors — Publication C-25, 62 pp, is designed to help make the selection of bus conductors easier. Included in booklet are tables regarding such shapes as channels, ventilated square tubes and round tubes. There are tables for other rigid bus conductor shapes, also data on bare copper wire and cable as well as commonly used alloy wires. Also provided is a general discussion of copper, its physical and electrical properties. Photos illustrate many installations. The American Brass Co.

254 Selecting Protective Devices — The Protection Handbook, 24 pp, is based on the 1956 National Electrical Code, and interprets this code into easily read form. It covers the selection of protective devices for electric circuits, motors, appliances and apparatus, and includes a list


FOR PRODUCTIVE MAINTENANCE
DURING PLANT SHUTDOWN
MEGGER LOW RESISTANCE OHMMETER
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MEGGER INSULATION RESISTANCE TESTERS
BIDDLE IMPULSE CABLE FAULT LOCATOR
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"TTR" TRANSFORMER TURN RATIO TEST SET

USE **BIDDLE** INSTRUMENTS
FOR ELECTRICAL TESTS

More and more plants are adopted the policy of a complete shutdown for summer vacations. Where possible, it surely pays off, because machines get "tired" too . . . and preventive maintenance can make them well before they get sick. Especially if (in the case of electrical equipment) you use

MEGGER® INSULATION RESISTANCE TESTERS

. . . or any other testing instruments in Biddle's full line of equipment for the practical electrical man. Biddle's File "21" contains a selection of articles and check charts showing how preventive maintenance becomes productive maintenance by saving you thousands of dollars in "unscheduled" downtime costs.

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is a vitally important instrument for summertime maintenance. Experience shows that ground resistance *does not remain constant* and tests should be made at least once a year to discover high ground resistance and correct it before lightning strikes. Biddle File "25" gives you a lot of "know-how" to head off costly damage from electrical storms.

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B-706

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showing the size to use when ordinary fuse, Fustron dual-element fuse or Fustat is installed. All information is condensed. Fully illustrated, book gives wiring diagrams, motor tables. Bussman Mfg. Co.

WATER CONDITIONING

255 Water Conditioning Data Book — An excellent reference volume, Data Book 2478A contains 108 pp and presents a compilation of 78 chapters and tables. Subjects covered include hydraulics; impurities in water; chemical conversions; coagulant, acid and alkali dosages; chemicals used in water treatment; water treatment processes; boiler feed make-up requirements; alkalinity relationships; specific gravities; chemical reactions. Available to qualified power engineers, please state your job title when requesting this. The Permutit Co.

256 pH and Chlorine Control — The 12th edition of company's handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrite, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium, magnesium, silica nitrate hardness. Available to qualified power engineers. W. A. Taylor Co.

257 Ion Exchangers — Sixteen-pp Bulletin 1960-C, on ion exchangers, discusses the principles of cation and anion exchange, and the practical operation of ion exchangers. General properties of company's ion exchange materials are given. A chapter is devoted to design features of manufacturer's ion exchange equipment. Installations of these exchangers are illustrated. Infilco Inc.

258 Feedwater Treatment — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains why direct treatment is convenient, economical. National Aluminate Corp.

259 On Biological Fouling — Eight-pp Technical Paper 134 discusses biological fouling in recirculating cooling water systems. Covers common problems of slime and algae in this system and points out how deposits of biological origin can interfere with heat transfer. A discussion of control agents for overcoming this situation and selection of proper toxicant is included. Betz Laboratories, Inc.

260 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

261 Feed Water Deoxygenation — The advantages of chemical deoxygenation of boiler feed water with an aqueous solution of hydrazine are described in 12-pp Bulletin BW 5. How hydrazine serves to maintain boiler in cleanest possible condition, reducing iron oxide scale to a magnetic oxide, is fully detailed, and such considerations as economy and operation, handling precautions, storage are covered. Fairmount Chemical Co., Inc.

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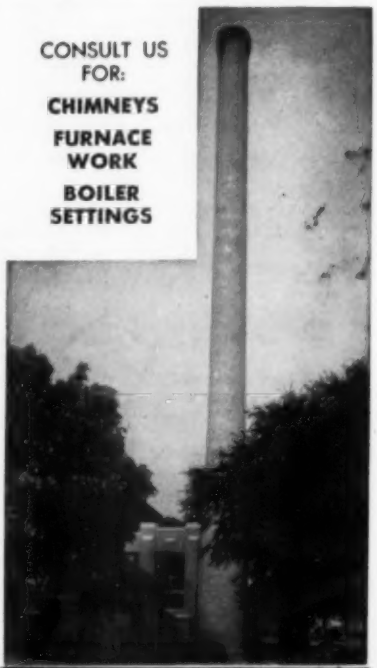

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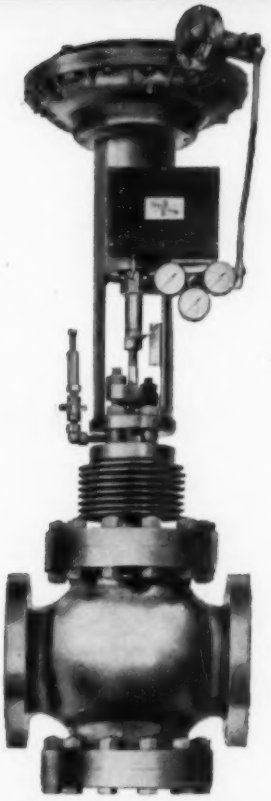

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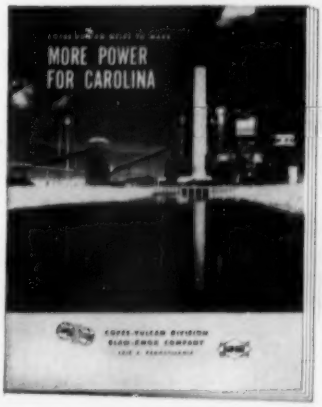
On-the-job report on boiler control

How Copes-Vulcan helps make more power for Carolina Power and Light Company is covered in this factual report on the Louis V. Sutton plant. Highlights include: Combustion, feed water, boiler feed pump re-circulation controls plus automatic-sequential soot blowing. Write for Bulletin 1032.



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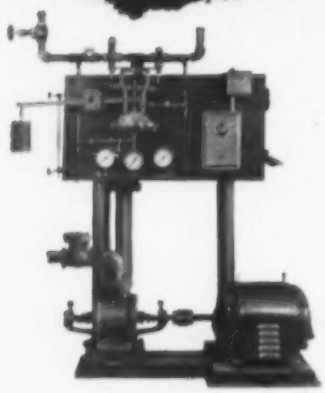

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OTHER EQUIPMENT

262 Product Guide — Manufacturing facilities for company's line of steam turbines, turbine generators, ship propulsion units, feed pumps, centrifugal compressors, blowers, centrifugal pumps, reduction gear, and other products are described in this profusely illustrated 50-pp catalog. Photos show manufacturing procedure. De Laval Steam Turbine Co.

263 Sectional Condenser — Bulletin 131 shows benefits of sectional-design refrigeration condensers for 100 to 240 tons refrigeration capacity and explains their functions with diagrams and installation photos. A cutaway shows component parts. Niagara Blower Co.

264 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

265 Steam Condensers — Advantages and features of company's line of steam condensers are detailed in this 24-pp catalog which pictures actual installations in typical power plants. Design data and an engineering section providing information on heat transfer rates, pressure drop, and other factors are included. Other sections cover air removal equipment, maintenance, and steam condenser specialties. Condenser Service & Engineering Co., Inc.

266 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

267 Feedwater Heaters — Open-Coil, tray-type feedwater heaters and purifiers of both deaerating and non-deaerating type are presented in 12-pp Bulletin 117-A. Construction and operational features of the heaters are explained and illustrated, and more than a dozen available models are pictured along with application suggestions. They cover capacities from 3000 to 300,000 lb per hour. Stickle Steam Specialties Co.

268 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

269 Turbine Speed Control — Thirty-pp wire-bound Bulletin H-21 is titled "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

270 Corrosion, Abrasion Control — Modern practices and products for the positive protection of metal equipment from the effects of corrosion and abrasion are described in this 16-pp bulletin. Covers factory and field application of rubber or synthetic linings to metal parts or products, and maintenance coatings available for application by plant personnel. Goodall Rubber Co.

271 Heavy Duty Fans — Eight-pp Bulletin 4824 describes new Airfoil centrifugal fans for heavy duty industrial applications. Discusses performance features and construction details of the fans. Text is supplemented with photos and drawings of wheel, housing, bearing, shaft. Several possible volume control methods that can be used with these fans are described and evaluated. Brake horsepower curves for four volume control methods are included. Amer can Blower Corp.

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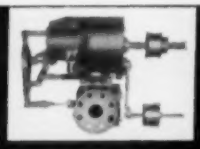

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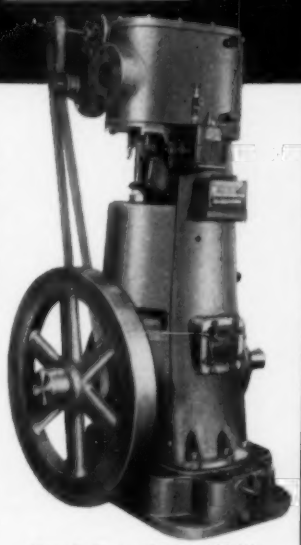

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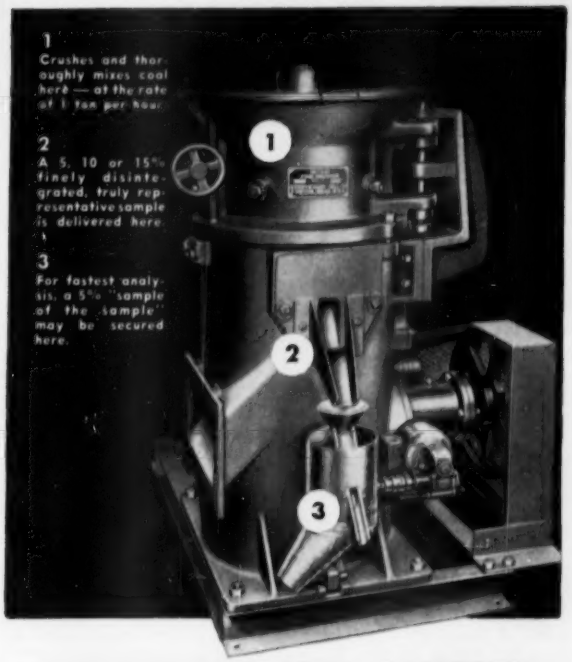
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Agency—The McCarty Co.
UNIVERSAL ATLAS CEMENT CO. ..... *
Agency—Batten, Barton, Durstine & Osborn, Inc.

VOGT MACHINE CO., HENRY 43
Agency—Farson, Huff & Northlich

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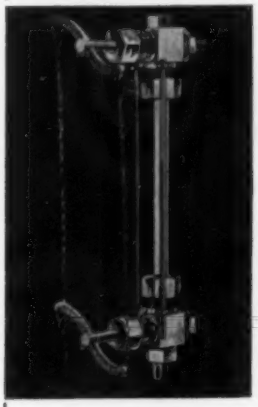
Agency—Michel-Cather, Inc.
WORTHINGTON CORPORATION ..... *
Agency—Needham, Louis & Brorby, Inc.

YARNALL-WARING COMPANY 8–9, 48
Agency—The Michener Co.

Firms whose advertising is not in this issue but is appearing in other issues is marked with an *

PBH Water Gauges

QUICK CLOSING—Gauges opened or shut with one quarter turn providing quick shut-off of danger and expense.



STEAM PROOF AND LEAK-TIGHT. Extra deep stuffing box nuts with ample size high quality composition packing.

MEET A. S. M. E. CODE. Valves are made of A.S.M.E. bronze stamped with maximum working pressure. Operating chain handles furnished complying with Code requirements.

All valves rigidly tested and inspected before shipment.

Send for a copy of Catalog A-51

●

Our 61st Year

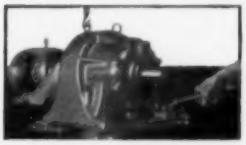
THE PAUL B. HUYETTE CO., INC.

401 NORTH BROAD STREET PHILADELPHIA 8, PA.

For more data circle 563 on Post Card

Designed to meet J.I.C. Specifications

In one compact power package a high-speed NEMA foot-mounted motor and a low-speed, double reduction gear transmission. Motor change in minutes! And with U. S. Motomount Syncrogear, the change is not limited to the type motor being replaced! If *you* carry a spare motor inventory, here is real flexibility and quick-change. U. S. Uniclosed, Totally-Enclosed, or Explosion-Proof motors of the same NEMA dimensions and ratings may be used to meet changing requirements. Available in h.p. ratings 1 to 30. U. S. Motomount Syncrogear has solid shank ever-tight pinion, friction-free oil seal, thru-hardened gears—many advanced features for longest life.



◀ **MOUNTS LIKE AN INTEGRAL UNIT, FOR INHERENT ALIGNMENT** . . . Both units of the U. S. Motomount Syncrogear have rugged, pyramidal base construction – made-to-match pyramids to hold motor and mount aligned for life—factory alignment PLUS centralized responsibility for manufacture of both components.

◀ **CAST IRON FOR ALL EXTERNAL PARTS** . . . For tough, industrial duty! Besides providing structural stability, cast iron protects against corrosive elements. All castings normalized for permanent retention of precision machining.

◀

U.S. Electrical MOTORS

MOTORS U.S.

MAIL COUPON NOW ▼

U. S. ELECTRICAL MOTORS, Inc. POE-7
P. O. Box 2058, Los Angeles 54, Calif., or Milford, Conn.
☐ *Request Full Information about Motomount Syncrogear*

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE ___ STATE _____

For more data circle 565 on Post Card

For use wherever threaded connections are subjected up to 1800°F. temperatures such as boiler, manhole, face plate studs, cylinder heads, and manifold studs or flange bolts on high temp steam lines and pumps.

Try C-5 and see why manufacturers, refiners and power producers have made it a part of their regular preventative maintenance program.

fel-pro C5 "HIGH-TEMP"

- ✓ Ends Seizing and Galling even up to 1800°F.
- ✓ Reduces Wrench Torque
- ✓ Ends Stud Breakage
- ✓ Permits Repeated Re-use
- ✓ Speeds Assembly and Disassembly
- ✓ Protects Stainless Steel at all Temperatures

1614-B

ANTI-SEIZE THREAD COMPOUND

C-5's exclusive colloidal copper formula separates mating metal threads and surfaces with cushioning, protective copper plating. C-5 prevents galvanic action and eliminates pitting even when dissimilar metals join. On mating metal surfaces, C-5 saves gaskets and countless man hours.

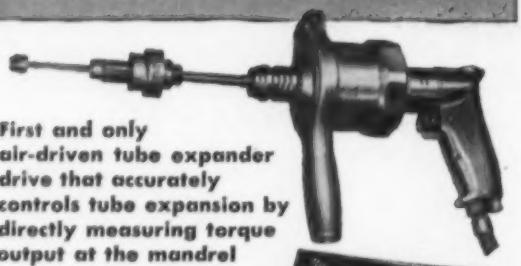
WRITE TODAY . . . For Your FREE Test Sample Can of C-5.

FELT PRODUCTS MFG. CO.
1567 Carroll Ave., Chicago 7, Illinois

For more data circle 564 on Post Card

For Expanding
Heat Exchanger Tubes

NEW WILSON Torq-Air-Matic



First and only air-driven tube expander drive that accurately controls tube expansion by directly measuring torque output at the mandrel

Only the Wilson Torq-Air-Matic offers all these features: air driven, automatic trip-off, completely integrated, non-electrical, non-frictional, calibrated in ft lbs torque, lightweight, simply adjusted.

Send for your copy of Wilson Bulletin 55.

Wilson Heavy-Duty Air Driven Cleaners

offer quick way to clean fouled heat exchanger tubes

Wilson Tube Cutter

easy to use, does fast job, a fine, reasonably priced tool

Representatives in principal cities
Thomas C. Wilson, Inc. • 21-11 44th Ave., Long Island City 1, N. Y.
Cable address: "Tubeclean", New York

WILSON TW-859

TUBE CLEANERS • TUBE EXPANDERS

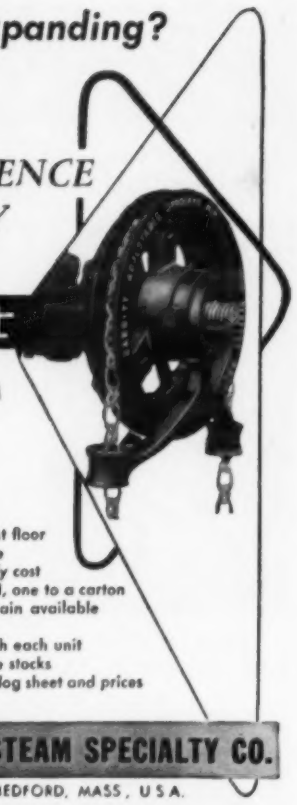
For more data circle 566 on Post Card

Building or Expanding?

THINK of
SAFETY
CONVENIENCE
ECONOMY
THINK of

Babbitt

Adjustable
SPROCKET RIM
with Chain Guide



- Simplifies pipe layout
- Fits any size valve wheel
- Easy to install and operate
- Operates any valve from plant floor
- Time and money saving fixture
- No maintenance; first cost only cost
- Packed, completely assembled, one to a carton
- Hot galvanized, rust-proof chain available for all sizes
- Easy to follow instructions with each unit
- Your supplier carries complete stocks
- Write for new descriptive catalog sheet and prices

Babbitt STEAM SPECIALTY CO.

4 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

For more data circle 567 on Post Card

ELECTRIC MOTOR CLEANER

WRITE FOR MORE INFORMATION

BUT HEAR THIS

Motors can take their own baths by being submerged, and run without shorting, in KO9 Safety Solvent. A few minutes after being dunked they emerge cleaner than most manual cleaning jobs can make them. KO9 Cleaner and Degreaser evaporates completely without any residue remaining. After a KO9 bath, away go dirty, greasy, waterlogged, fouled up motors . . . good as new. This special electrical safety solvent is fine for spraying large motors, and for cleaning or degreasing meters, generators, switches, panels, fans, windings, communication systems, refrigeration lines, instruments, and all component parts.

KOR CORPORATION
Division of Dri Corporation
600 WEST 9th AVENUE, GARY, INDIANA

For more data circle 568 on Post Card

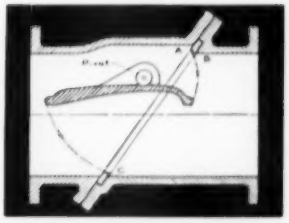
You have to see it to believe it . . .

(You Can't Hear It!)

CHAPMAN Tilting Disc Check Valve

It's the silent valve. No noise, no vibration, no fluttering. On usual piping arrangements you get no slamming with a Chapman Tilting Disc Check Valve. You get no banging to cause damage to system or valve . . . no grinding, scraping or wearing of either the disc or seat. Your maintenance costs go down to an unbelievable low which is really something to see and enjoy.

You can safely use these valves under tough operating conditions. You can order them in iron and steel . . . for handling fluids or gases under a wide range of pressures. You can get them fast. See our Catalog 30-A. Write for your copy today.



Look at this operational chart. When the flow is on, "airfoil" disc is held firmly against stops in the body. When the flow drops, disc balances quietly on whatever flow there is. When flow stops, disc drops quickly, quietly and firmly on special bevel seat. Note that sufficient space is designed around disc to cut down flow resistance.

THE CHAPMAN VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASSACHUSETTS

For more data circle 569 on Post Card

PERMUTIT® presents the

VALVELESS FILTER

Completely Automatic Gravity Filter Costs Less than Manual Unit

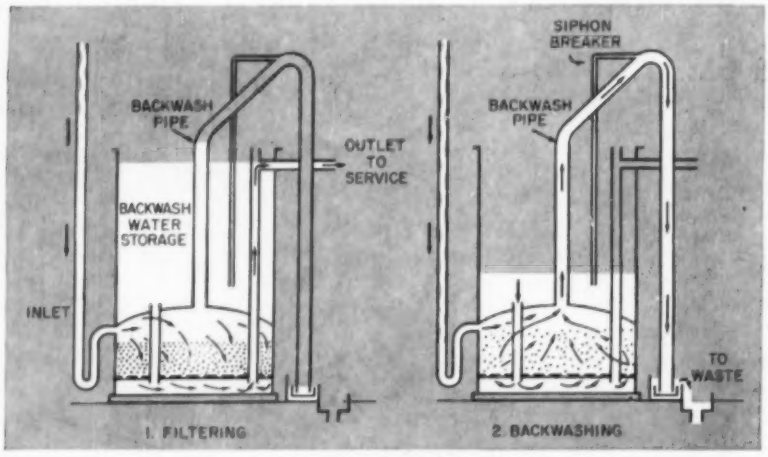
Uses no valves, no pumps, no flow controllers

Here's an entirely new concept in water filters for cities, factories and power stations: a filter that *eliminates* operation and maintenance expense . . . yet costs *less* than a conventional manually-operated gravity filter of the same size.

The Permutit Valveless Filter can be used wherever gravity flow is feasible. Units are now in operation providing both plant process and drinking water.

FOOLPROOF OPERATION

The Valveless Filter thinks for itself. It starts backwashing at a predetermined head loss, rinses and returns to service automatically . . . and as efficiently as an expertly operated manual filter. It assures uniform, high quality effluent because it eliminates "human error." It cannot be forced. It cannot backwash or rinse too soon or too late, too fast or too slow, too much or too little. It cannot develop a negative head and thus eliminates the chief cause of mudballs, channelling, upset beds. The absence of gravel eliminates another cause of upset beds. Backwash or rinse water cannot be accidentally run to service.



HOW IT WORKS

Filtering. Water enters at left, flows through sand, strainers and false bottom up effluent duct to service. As head loss increases during run, water rises in backwash pipe. At maximum headloss, water spills into downward section of backwash pipe and starts backwash (siphon) action.

Backwashing. Siphon draws water from storage down through ducts, up through strainers and sand to expand and wash bed, then to waste. At low storage level, air enters siphon breaker to stop backwash. Flow reverses and filtered (rinse) water flows into storage until full. All flow then goes to service.

PROVEN PERFORMANCE

Photo shows two Valveless Filters in a large industrial plant. (Shut-off valve at left is used only to take front filter out of service.)

LOW INSTALLATION AND EXPANSION COST

Filters up to 10 ft. diameter are shipped set up. Piping is simple. Future filters are easy to add since they require no additional backwash water storage or pump capacity. Filters use minimum floor space.

FREE BULLETIN

New bulletin, "The Permutit Valveless Filter," includes details, drawings, operating conditions, capacities. Address: The Permutit Company, Dept. PE-7, 50 West 44th St., New York 36, N. Y. or Permutit Company of Canada Ltd., Toronto 1, Ont.

PERMUTIT®

rhymes with "compute it"

Water Conditioning

Ion Exchange • Industrial Waste Treatment

For more data circle 570 on Post Card